LK SERIES PLC

Hardware Manual

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Preface

LK series PLC is a new generation of smart PLC products by HollySys applicable for medium to high performance controls. LK is designed based on the combination of technologies such as computers, controls, communication, and signal processing together with the vast in-field project experience and knowledge in automation and control implementation. Versatile are the key features in LK PLC providing customized solutions and application suitable for various industrials. It is best suited for logic control, sequence control, process control, transmission control, and motion control. The LK PLC consists of the integration of various kinds of modules, such as CPU, Communication, I/O, or Special Function on the backplane forming a complete working unit. The controller itself is modular and the system architecture is expandable. It is also important to provide redundancy in automation control and LK series PLC is designed with redundancy in mind, from the field bus communications network, to the I/O modules, the CPU controller modules, the power supply, and even the industrial Ethernet communication for the operation management level.

Feature Highlights

Modular Design
Redundancy System
Easy Installation and Wiring
Powerful Instructions and Functions
Advanced Programming Software – PowerPro for Windows

Contents

"LK Series PLC – Hardware Manual" is a technical manual designed to give detailed information of all the LK Series PLC hardware which includes:
Local and Expansion backplanes
CPU Modules
Communication Modules
I/O Modules
I/O Terminal Block
Special Function Modules
Power Supply

Application Scope

The content of this manual is application to LK Series PLC

How to Use

It is suggested to read the whole manual for any first time user with PLC. Experienced users can refer directly to the relevant hardware sub-component pages that you are interested with.

Other References:

LK PLC -- Overview
LK PLC -- Selection Guide
LK PLC -- Software Manual
LK PLC -- Instruction Sets Reference Manual

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CHAPTER 1: INTRODUCTION

LK series PLC is the result of HollySys' years of experience in automation and control fully absorbing the best technology in industrial electronics and industrial control strictly complying with the international industrial standards. It fulfills and copes with ease the system requirements and needs for both discrete and continuous process automation applications.

LK series PLC is a quality product equip with high reliability, feature-rich, high-performance, high integration, scalability, compact in size, and ease of use. LK series PLC is versatile in applications providing personalized solutions for various industrial sectors such as power and energy, petrochemical and chemical, metallurgy and mining, building materials, light industry, transportation, automobile, water treatment, food processing and many other industries.

Comparing with traditional PLC, the LK series PLC product fully integrates the advantages of both the traditional programmable logic control and the process-oriented DCS delivering a hybrid PLC and DCS product suitable for a wide variety of application for many industries. It embodies the standard characteristic of a traditional PLC but enhanced with a fast processing speed in discrete control, advantages of DCS such as the feature-rich analog control, redundancy, hot-swap, and the emphasis on high reliability in a continuous process, totally integrated, an open system, and relatively low-cost product.

1.1 HARDWARE COMPOSITION AND STRUCTURES

The LK PLC consists of a set of hardware modules which includes the CPU modules, communication modules, I/O modules, high-speed I/O modules, and special function modules that can be combined and configured on the backplane to satisfy a broad range of automation control applications.

Figure 1.1: LK backplane and the modules

A typical 3 slot local backplane LK controller as shown in Figure 1.2 consist of a CPU module, communication module, and an I/O module. The backplane provides the interfaces for 10/100Mbps Ethernet, redundancy Profibus-DP terminal points, and RS-485/RS-232 terminal points, DB9 RS-232, and the redundancy power supply input points.

Figure 1.2: A typical 3-slots Local Backplane LK Controller

1.1.1 Local Backplane

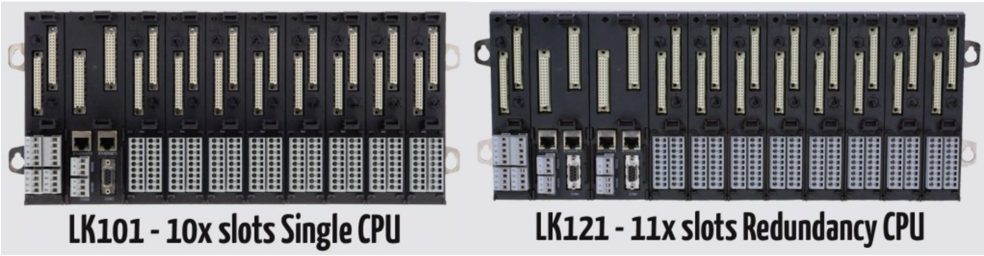


Figure 1.3: Local Backplane with build-in I/O terminal points

- Two variations are available.
  - Backplanes with build-in I/O terminal points. (refer to Figure 1.3)
  - Backplanes without I/O terminal points but extended via cabling with the help of using I/O terminal blocks. (One terminal block per I/O module). By using terminal blocks, this provides a much safer way of interconnections with field devices with proper isolation and some other specific purposes for different I/O application.
- Requires 1x Profibus-DP communication module, generally LK231, for communication.
- Requires 1x CPU Module.
- I/O modules can be installed on the local backplane.
- High-speed I/O modules can be installed on the local backplane.
- Special function modules can be installed on the local backplane.

1.1.2 Expansion Backplane

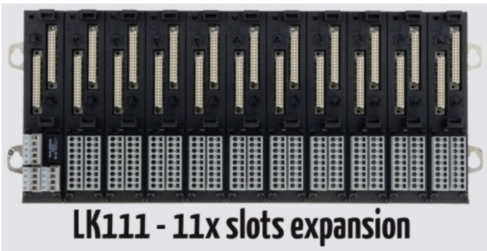


Figure 1.4: LK111 – 11-slots Expansion Backplane

- Requires 1x Profibus-DP communication module, generally LK231, for communication with the LK controller.
- Additional I/O modules can be installed on the expansion backplane.
- Special function modules can be installed on the expansion backplane.

1.1.3 Communication Module

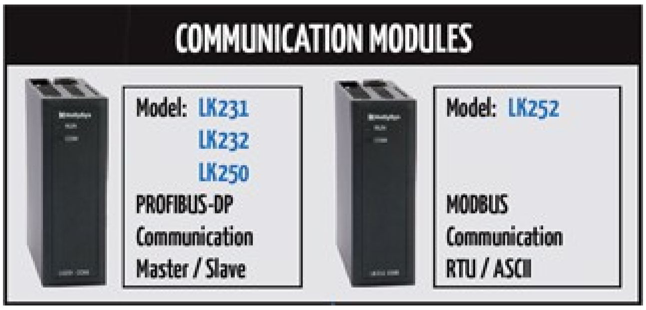


Figure 1.5: The LK Communication Modules

- Must be installed on both the Local Backplane and Expansion Backplane.
- Provides the system architecture expansion and other third-party product communication.
- Supports various popular communications such as PROFIBUS-DP, MODBUS, etc.

1.1.4 CPU Module

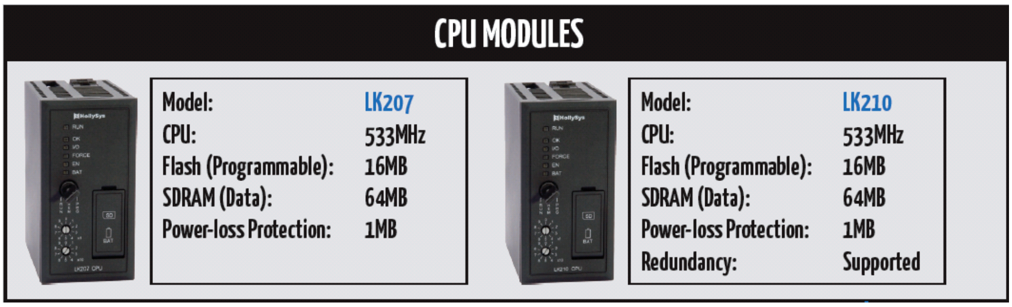


Figure 1.6: The CPU Controller Modules

- This is the main controller of the whole control system. It is responsible for execution of the programmable logic and the data communications with all the modules.
- Communications with the modules installed locally on the local backplane are done via internal data bus at normal or high-speed baud rate.
- Communications with the expansion I/O modules are done via the PROFIBUS-DP fieldbus.
- Communications with the operator level are done via Industrial Ethernet.
- On the front panel of the CPU module, you will find the LED status indicator, operating mode switches, rotary switches for addressing, SD memory card and backup battery compartment.

1.1.5 Normal-speed I/O Module

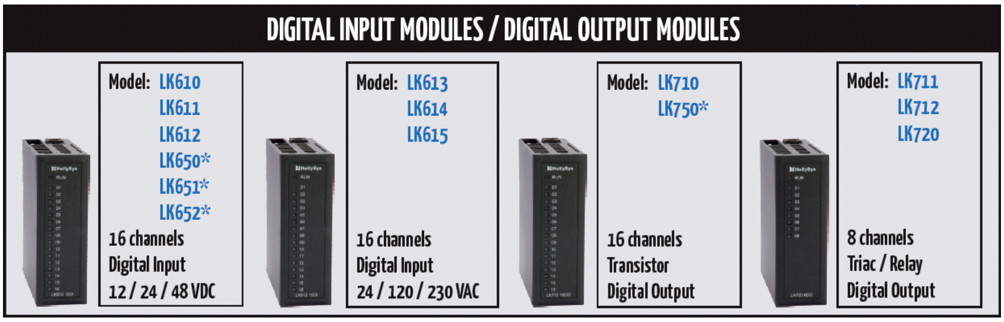


Figure 1.7: The LK DI / DO Modules

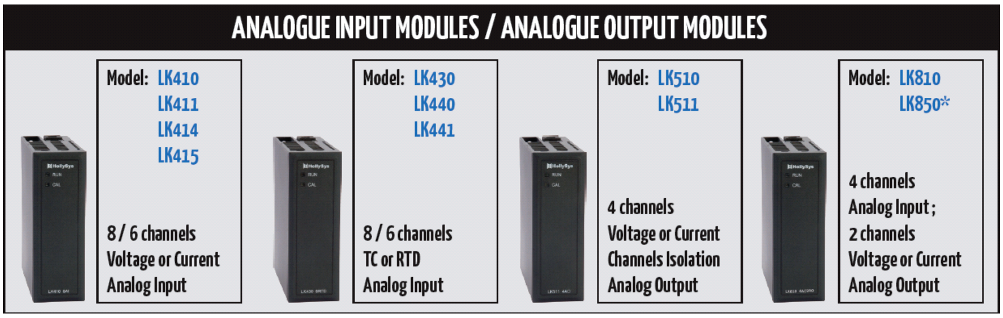


Figure 1.8: The AI / AO Modules

- Can be installed on the Local or Expansion Backplane.
- Various digital and analog I/O modules available such as sink/source, AC/DC, transistor/TRIAC/relay, current/voltage/RTD/thermocouple to meet different scenarios of applications.

1.1.6 High-speed I/O Module

- Installed only on the Local Backplane.
- These are I/O modules specially designed to be installed only on the Local Backplane in which data transfer between the CPU and I/O are running at high-speed bus of 32Mbps baud rate fulfilling high-speed I/O scanning application.

1.1.7 Special Function Module

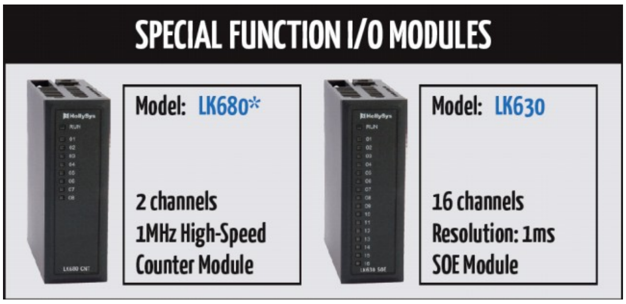


Figure 1.9: LK Special Function Modules

- Modules designed for special purpose application such as frequency counters and sequence of events (SOE), etc.

1.1.8 Terminal Block Module

Figure 1.10: LK Terminal Block Module

- This is required for the backplanes without I/O terminal but extended via cabling. It provides the I/O terminal points to connect to the field devices. Various types of terminal block shall be available to cater for extra precaution needs such as isolation, safety, and additional terminal requirements.

1.1.9 Power Supply Module

Figure 1.11: LK Power Supply Module

- Providing power to the LK backplane and modules.

1.2 TYPICAL LK HARDWARE SYSTEM ARCHITECTURE

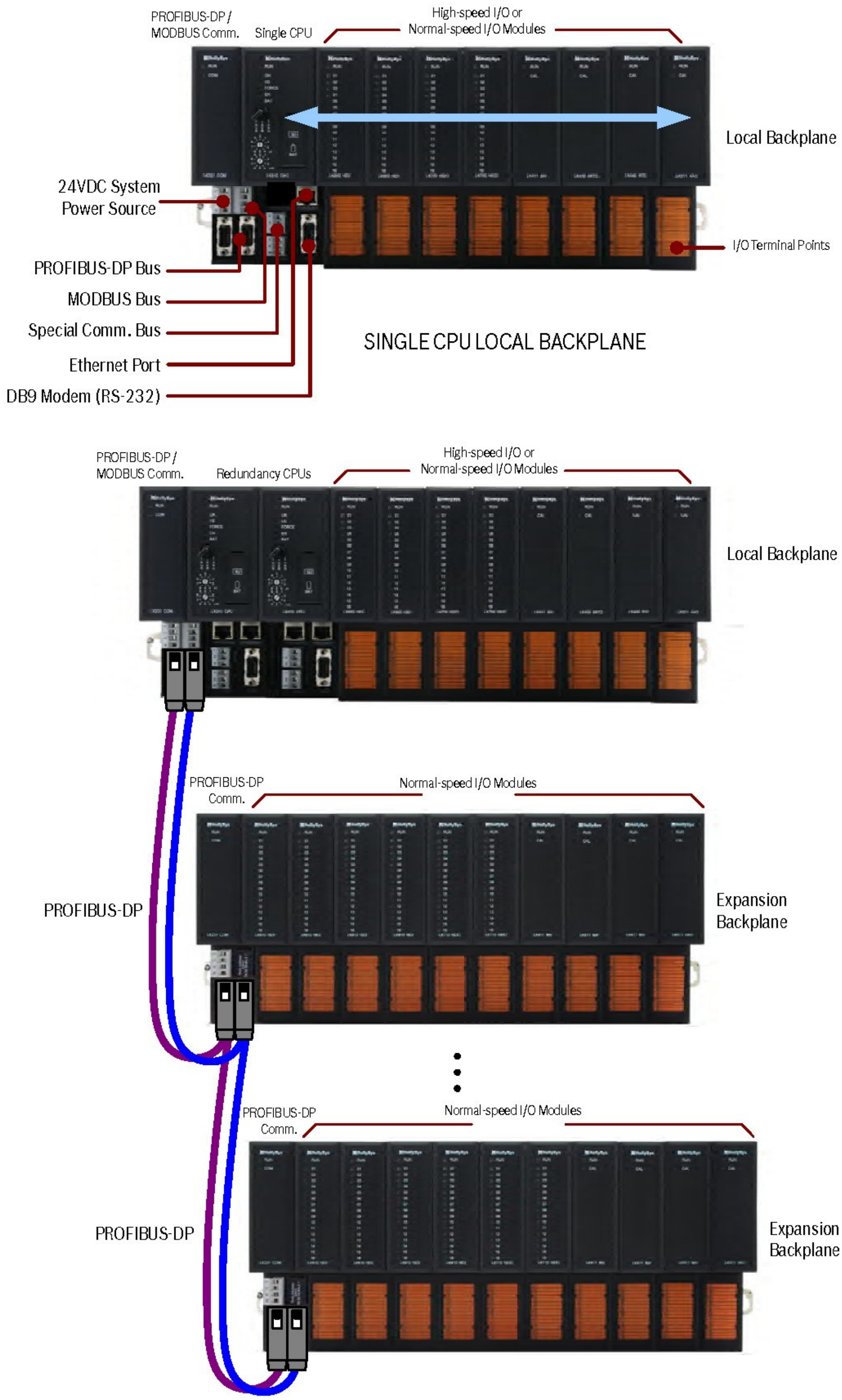


Figure 1.12: Typical LK Hardware System Architecture

1.3 TECHNICAL CHARACTERISTIC

LK controller configuration utilized the 533MHz or 266MHz with a nanosecond processor speed delivering prominent advantages in terms of speed, performance and functionality.

1.3.1 High-performance, Miniaturization, Modularity, Low power consumption

- A single word operation with the fastest execution time of 13 nanoseconds.
- A single controller with a maximum I/O expansion of up to 57,344 digital points, or 3548 analog points.
- In addition to the CPU controller which can support 2x independent serial ports, 1x Ethernet interface (or 2x independent Ethernet interface / hot-swappable redundancy Ethernet), and 2x hot-swappable redundancy PROFIBUS-DP bus, but also can be extended to support external communications expansion module such as MODBUS and in-future other types of widely used protocols such as DeviceNet through newly developed communication module(s).
- The modules and wiring terminals are separate upper and lower terminals for easy wiring installation which can greatly save time and ease of system maintenance.
- Low power consumption CPU controller module draining 6 watts and I/O module draining 2 watts per module.

1.3.2 Standardized and Open Design

- An open software architecture design for different types of HMI software provides a standard OPC interface.
- Programming software complies with international standards IEC61131-3 (five programming languages) supporting Instruction List (IL), Ladder Diagram (LD), Function Block Diagram (FBD), Sequential Function Chart (SFC), and Structured Text (ST). However, it also supports the continuous process control programming language, a classical way of control system programming using Continuous Function Chart (CFC), blocks, and diagrams.
- Provides sequence and process control using commonly used standard algorithm.

1.3.3 Optional Redundancy

- Controller redundancy can be achieved using the same local redundancy backplane with 2x CPU modules. One CPU acts as the primary controller and the other acts as secondary controller. Both CPU received network data at the same time and does its control logic and algorithms processing, but only the master controller outputs its calculated results with real-time updating of data while the slave does not output any control command. In the event of a failure in the primary controller, the secondary controller will switch over seamlessly. This way of redundancy configuration greatly enhanced the PLC system and its ability of continuous operation.

1.3.4 Fault Detection with Self-diagnostic Features

- Most of the commonly used I/O modules are equipped with fault detection features. It periodically conducts self-diagnosis, and diagnosis results are reported to the CPU controller. Different types of self-diagnostic features are shown in Table 1.1.
- At the same time, all modules on the panels have different colored LED status indicator such as “Running”, “I/O Channels”, “Network communication” and so on. The different LED status indicator such as light-on, light-flashing, and light-off provides a clear indication of the operational status of the module.

Types of Module	Types of Self-diagnostic
Analog Input	Over Limit Alarm (High / Low), Over Range Alarm (Top / Bottom), Open-Wire Detection, Calibration Data Error Detection
Analog Output	Output Read-back Self-comparison, Open-Wire Detection, Output Channel Fault Detection, Overload Detection
Digital Input	Operational Power-loss Detection
Digital Output	Output Read-back Self-comparison, Operational Power-loss Detection, Channel Power-loss Detection

Table 1.1: Different Types of Self-diagnostic Features for various modules

1.3.5 Hot-Swappable Module

- All the modules (communication, CPU and I/O module) support hot-swappable. In an event of a module failure, replacement can be made instantly without affecting the system in operations.

1.3.6 High-Speed I/O Module

- All the local backplane supports high-speed data bus which enables high-speed 32Mbps I/O data exchange between the CPU and the I/O modules with an access time of approximately 2.6 microseconds every byte.

1.4 COMMON SYSTEM SPECIFICATIONS

Power	24VDC	Power Supply	24VDC (-15%, +20%)
		Ripple	<5%
		Reverse Polarity Protection	Supported
Electromagnetic Capability	Immunity	Electrostatic discharge	IEC 61000-4-2: contact discharge 4kV, environment discharge 8kV
		Radio-frequency radiated electromagnetic field	IEC 61000-4-3: 80MHz ~ 1GHz, 10V/m using 1Khz signal 80% modulation
		Electrical fast transient / burst	IEC 61000-4-4: 1kV
		Surge	IEC 61000-4-5: wire-to-wire 1kV
		Conducted disturbances, induced by radio-frequency fields	IEC 61000-4-6: 10V (0.15 ~ 80MHz)
		Magnetic Field Power Frequency	IEC 61000-4-8: Stability and continued testing of magnetic field strength, 30A / m
	Radiation	Radiated interference	IEC 61131-2: 30 ~ 230MHz, 10m Quasi-peak is less than 40dB (μV/m) 230 ~ 1000MHz, 10m Quasi-peak is less than 47dB (μV/m)
		Conducted Interference	IEC 61131-2: 0.15~0.5MHz, 10m Quasi-peak is less than 40dB (μV/m) 0.5 ~ 30MHz, 10m Quasi-peak is less than 47dB (μV/m)
Environmental Specification	Environmental	Operating Temperature	0℃ ~ +60℃
		Operating Humidity	5% ~ 95% (non-condensing)
		Operating Elevation	0 ~ 3000m
		Storage Temperature	-40℃ ~ +70℃
		Storage Humidity	5% ~ 95% (non-condensing)
		Vibration Resistance	IEC 60068-2-6: 1G (9.8m/S2) (Range: 0.3mm, Resistance to vibration from 10 ~ 150Hz along all axes)
		Shock Resistance	IEC 60068-2-27: 15G (147m/S2), 11ms along 6 axes
		Dump or overturned	IEC 60068-2-31: 50mm, overturn 4 times
		Freefall drop	IEC 60068-2-32: 1m, drop 5 times
	IP Protection	Degree of International Protection	IEC 60529: IP20 (protected against solid bodies of superior dimensions to 12 mm, protect against the access with a finger, No water proof)

Table 1.2: Common system specification of LK Hardware

1.5 HARDWARE DIAGNOSTIC

Different types of I/O module provide different types of hardware self-diagnostic capabilities as shown in Table 1.3. All the diagnostic information and data are reported back to the CPU controller via the local backplane data bus or the PROFIBUS-DP data bus. Using the programming software, special diagnostic function block is available for usage to configure or read-back a variety of diagnostic data from the operational field devices.

Configuration of the alarm parameters is made directly on the I/O modules' user parameter settings. For example, whether to enable the alarm threshold and so on, as shown in Figure 1.13

Programming is made simple and convenient with drop-down menu design. Diagnosis of the existing system level is clearly identified. For the entire class of equipment from the station diagnosis, the channel-level diagnosis, and each module's alarm parameter for each channel is all on separate settings, non-interfering one another.

For more details on hardware diagnostic, please refer to the section "Parameter Specification" under every individual module specification throughout this manual.

Hardware implementation of these diagnostic features is as follows:

- At the configuration of alarm parameters on the I/O modules' user parameter, each parameter has a default value, usually optimize towards commonly used engineering value for safety and recommendation. The user can choose to use the default value or make any further changes.
- At the usage of diagnostic function block to read-back the diagnostic data, the self-diagnostic functions can be classified into three types:
    - **Equipment Diagnostic Functions**: Used to record module's overall diagnostic information, such as operational power-loss detection.
    - **ID Diagnosis Functions**: Used to record whether or not the module has diagnostic information.
    - **Channel Diagnosis Functions**: Use to record the level access for diagnostic information, such as channel fault detection, over-limit, etc. and so on.

Types of Module	Types of Self-diagnostic	
	Equipment Diagnostic	Channel Diagnostic
Analog Input	Calibration Data Error Detection	Over Top-Range, Under Bottom-Range, Over High Limit, Under Low Limit, Open-Wire Detection
Analog Output	Calibration Data Error Detection	Open-Wire Detection, Output Channel Fault Detection, Overload Detection
Digital Input	Operational Power-loss Detection	-----
Digital Output	Operational Power-loss Detection	Channel Power-loss Detection

Table 1.3: Different types of self-diagnostic Features for various modules

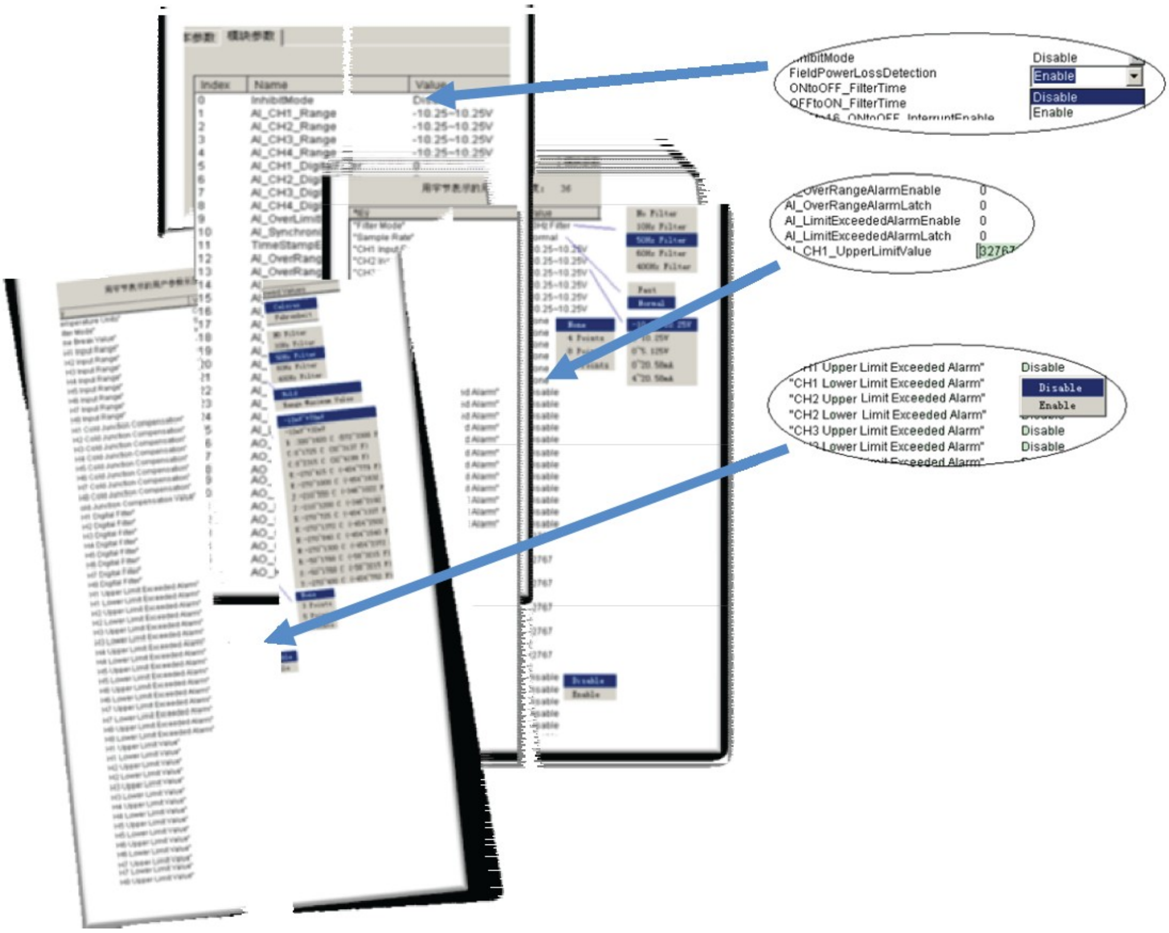


Figure 1.13: The User Parameters' selection in PowerPro Software

1.6 PLANNING AND CONFIGURATION

1.6.1 Power Consumption calculation

For safety reasons, it is recommended that all the total power consumption of all the modules does not exceed 70% of the selected power supply. Table 1.4 shows a list of all the power consumption of each module.

IMPORTANT!! This table reflects only the LK system power consumption. It does NOT include the on-site power consumption for equipments such as switches, load, transmitter, and other field devices. In order to ensure proper electrical isolation between the LK system and site, the entire on-site power requirement should not share with or borrow from the LK system power or it will leads to the damaging of the LK hardware and system.

Types of Module	Product Code	Rated Voltage	Current (max.)	Power
Power Supply	LK910	24VDC	5A	120W
CPU Controller	LK207	24VDC	250mA	6W
	LK210	24VDC	250mA	6W
AI	LK410	24VDC	100mA	2.4W
	LK411	24VDC	60mA	1.44W
	LK414	24VDC	50mA	1.2W
	LK415	24VDC	100mA	2.4W
	LK430	24VDC	60mA	1.44W
	LK440	24VDC	60mA	1.44W
	LK441	24VDC	60mA	1.44W
AO	LK510	24VDC	125mA	3W
	LK511	24VDC	180mA	4.32W
AI+AO	LK810	24VDC	150mA	3.6W
	LK850	24VDC	180mA	4.32W
DI	LK610	24VDC	50mA	1.2W
	LK611	24VDC	50mA	1.2W
	LK612	24VDC	50mA	1.2W
	Lk613	24VDC	50mA	1.2W
	LK614	24VDC	50mA	1.2W
	LK615	24VDC	50mA	1.2W
	LK650	24VDC	60mA	1.44W
	LK651	24VDC	60mA	1.44W
	LK652	24VDC	60mA	1.44W
DO	LK710	24VDC	70mA	1.68W
	LK711	24VDC	60mA	1.44W
	LK712	24VDC	60mA	1.44W
	LK720	24VDC	150mA	3.6W
	LK750	24VDC	80mA	1.92W
Special Module	LK630	24VDC	80mA	1.92W
	LK680	24VDC	80mA	1.92W
Communication Module	LK231	24VDC	60mA	1.44W
	LK232	24VDC	60mA	1.44W
	LK250	24VDC	100mA	2.4W
	LK252	24VDC	50mA	1.2W

Table 1.4: LK Modules' Power Consumption Requirement

1.6.2 Ethernet Connection

Complying with the IEEE802.3/u standards, The LK controller comes with single or dual redundant Ethernet interface which communicates at a baud rate of 10/100Mbps self-adaptive using the standard RJ-45 interface located at the LK local backplane. Network cables of either non-shielded or unshielded twisted pair are used.

The two redundant Ethernet ports of the controller with IP address defaulted to the subnet of 128 and 129. These are labeled as ETHERNET2 and ETHERNET1 using RJ-45 interfaces found in the LK local backplane. For network reliability and redundancy considerations, subnet 128 and 129 should be using a different network switches.

PLC controller(s) can be connected to the Industrial Ethernet bus via the Ethernet interface(s) using standards TCP / IP protocol or other protocol for communication with external devices to provide users with an open platform for distributed automation network.

All configuration, programming, and/or firmware download and upgrade can be carried out using the Industrial Ethernet connection. Connected HMI devices can be remotely controlled, real-time monitored, and operated. Industrial Ethernet can also be used for communication between multiple controllers, or with the OPC server which serve as the data exchange with third-party product.

The maximum number of network connections varies depends on different ways of implementation, number of external devices, the application protocol, and the number of controllers, etc. The actual network configuration cannot exceed the maximum allowable network capacity.

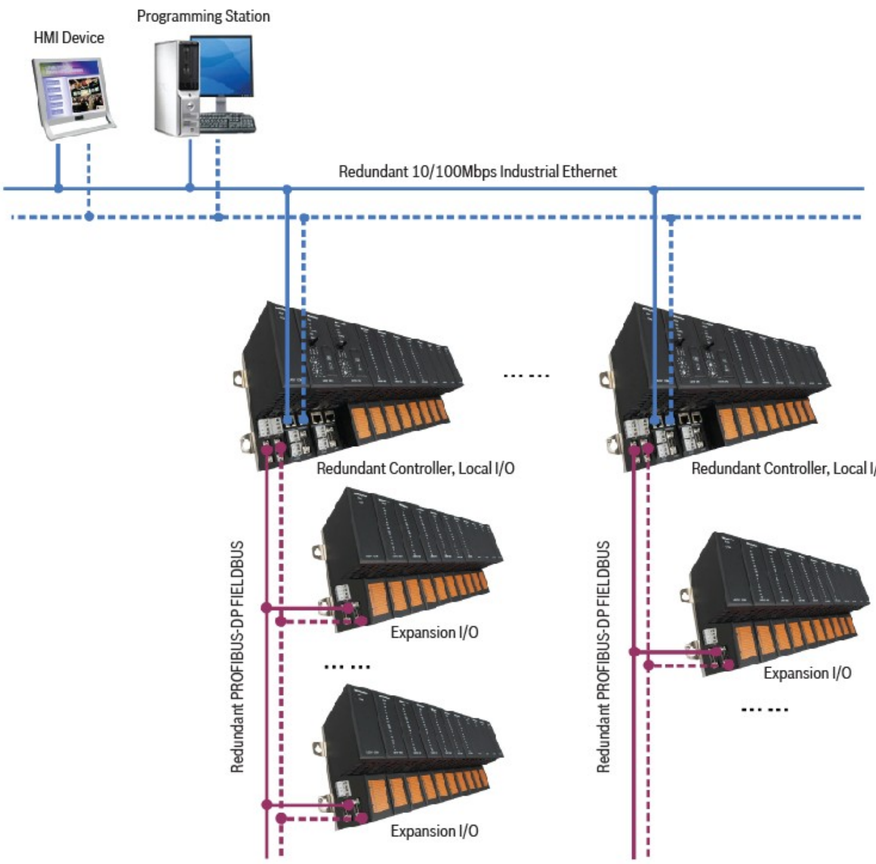


Figure 1.14: Ethernet and PROFIBUS- DP Connection

1.6.3 PROFIBUS-DP Fieldbus Connection

Figure 1.14 shows the LK PROFIBUS-DP fieldbus connection. Using redundancy PROFIBUS-DP (DP1 & DP2), I/O channels can be increase by using LK expansion backplane. The PROFIBUS-DP port on the LK local backplane uses two 4-pin terminal points or, for easy connection, two D-sub 9-hole socket are available. This are connect via the PROFIBUS-DP cable to the corresponding expansion backplane(s). The communication rate varies from 1.5M to 9.6kbps depending whether the DP-cable used (transmission medium) is shielded or unshielded twisted pair RS-485 cable.

During the planning of the LK hardware and system, all the logical node capacity, physical node capacity, and the estimation of all the nodes I/O bus scanning cycle needed to be carefully accounted for before calculating the total number LK backplanes needed.

- **Logical node capacity:** according to PROFIBUS-DP protocol, in theory, each logical network segment on the number of nodes up to a maximum of 127, the address node is 0 ~ 126 (address 126 for the radio communications). Each controller (DP master), I/O (DP slave station, including the DP slave LK250 module) occupy one address node. Address node 0 and 1 are fixed address reserved for the controller. Each I/O modules occupies one address node from 2 to 125.
- In order to support more DP slave module (I/O module), LK250 PROFIBUS-DP Network Extension module can be use. Each LK250 (main functions are transferred from the DP Master) forms a new DP network segment which can support additional 30 DP-slave module (I/O module).
- **Physical node capacity:** From electrical performance point of view, each physical link bus nodes are limited and bound by the number of transceiver and the bus current consumption characteristics.
- A general Profibus-DP transceiver can normally support up to 32 address nodes but in LK system, the Profibus-DP transceiver utilized only a quarter unit loads as compared to the general DP-transceiver. Similar, its current consumption is also a quarter lesser than the general DP-transceiver.
- Hence, LK system can directly support up to 128 nodes and do not need the use of DP-bus repeater devices. However, for safety reasons, we do not recommend that a physical bus section to install with so many nodes. Lk232 repeater module can be use to electrical isolate and sub-divide the data bus into separate section. At the same time, LK232 is usable together with LK250 network extension module and LK231 DP communication module, providing a wide variety of possible network topology.
- **Bus-scanning cycle:** Even if the calculations of the logical and physical node capacity are feasible, but the bus-scanning cycle (speed requirement) also needs to be taken into consideration for the final accounting.

1.6.4 The Bus-Scanning Cycle of the PROFIBUS-DP Fieldbus Network

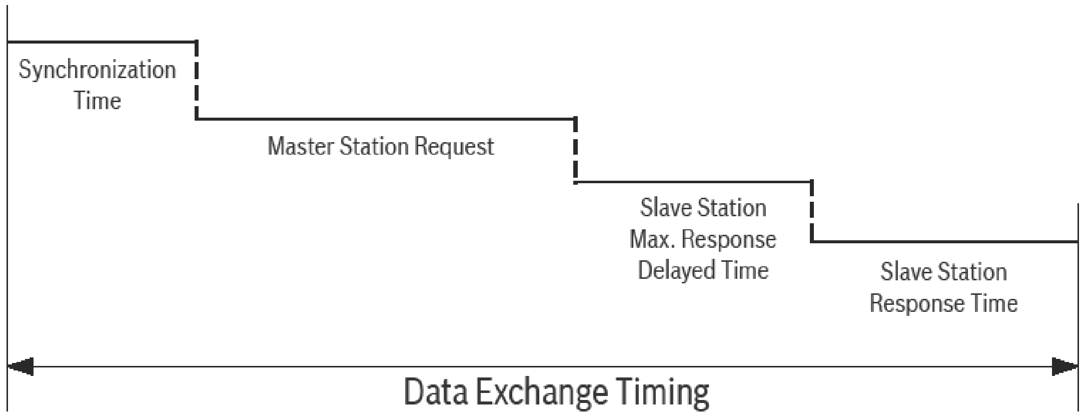


Figure 1.15: Profibus-DP Bus-scanning Cycle

The Calculation formula of a bus-scanning cycle time for a DP master module in a single data exchange is as follows:

Formula 1

$$\text{Data Exchange Timing} = \frac{\text{Synchronization Time} + \text{Master Station Request} + \text{Slave Station Max. Response Delayed Time} + \text{Slave Station Response Time}}{\text{Baud Rate}}$$

- *Where:*
- *Synchronization Time = 100bit*
- *Master Station Request + Slave Station Response = Module data packet length(Byte)*11bit, refer to Table 1.6*
- *Slave Station Max. Response Delay Time & Baud Rate, refer to Table 1.5*
    - *In the PROFIBUS-DP protocol, a valid byte of information transmission uses a total of 11bti (8bit data + 1bit start bit + 1 bit stop bit + 1bit parity bit)*

Baud rate (bps)	Slave station max. response delayed time (bit)
9.6K, 19.2K, 31.25K, 45.45K, 93.75K, 187.5K	60
500K	100
1.5M	150

Table 1.5 : The respond delayed timing under various baud rates

Therefore, Formula 1 can be simplified into

Formula 2:

$$\text{Data Exchange Timing } (\mu s) = \frac{100 + (\text{Data packet length} \times 11) + \text{Slave Station Max. Response Delayed Time (bit)}}{\text{Baud Rate (bps)}} \times 10^6$$

Table 1.6 shows a list of data exchange timing for commonly used baud rate of 500Kbps and 1.5Mbps, the rest of the baud rate of data exchange time can be calculated in accordance with the formula 2.

Module	Data Packet Length (Byte)	Data Exchange Timing (µs)	
		1.5Mbps	500Kbps
LK410	31	394	1082
LK411	31	394	1082
LK414	31	394	1082
LK415	27	364.67	994
LK430	27	364.67	994
LK440	31	394	1082
LK441	31	394	1082
LK510	18	298.67	796
LK511	30	386.67	1060
LK610	17	291.33	774
LK611	17	291.33	774
LK612	17	291.33	774
LK613	17	291.33	774
LK614	17	291.33	774
LK615	17	291.33	774
LK630	144	1222.67	3568
LK710	22	328	884
LK711	20	313.33	840
Lk712	20	313.33	840
LK720	20	313.33	840
Lk810	30	386.67	1060

Table 1.6: Data Exchange Timing for different modules using 500Kbps and 1.5Mbps baud rates.

1.6.5 Planning and Configuration for LK250

LK250 can support the maximum number of DP-slave station by the three following conditions:

- **Based on physical and electrical performance, the maximum number of DP-slave station a single LK250 can support is 30.** LK250 may cascade by a number of series expansion backplane but not more than 30 DP-slave stations (I/O modules). The expansion backplane is installed with the LK231 PROFIBUS-DP communication module.
- **All the DP-slave station's User Parameter should not exceed the total length of more than 239 bytes.** Refer to the Table 1.7 for a list of user parameter's data length for each module. For example: LK430 user parameter's data length is 36 byte. Hence, the maximum number of LK430 that can be supported by LK250 is 239/36= 6. When LK430 is more than 6, the programming will be compiled with error.
- All the DP-slave station total input / output data packet length should not exceed the LK250 maximum allowable data length (244 bytes). If exceeded, a pop-up message box will be prompts in the programming software and modules are not allowed to be added further. Under normal circumstances, the input / output data packet will not exceed 244 bytes in length.
- **In summary**: LK250 can support a maximum of 30 I/O modules provided the user parameters and the I/O data packet not exceeding a total length of 239 bytes and 244 bytes respectively. During the LK250 system configuration, we must in accordance with Table 1.7 as listed for different I/O modules, the user parameter length, and data packet length. *For more detail information, please refer to the chapter on LK250 [ProfiBus-DP NETWORK extension module].*

Module	User Parameter's data length (byte)	Data Packet length (Byte)	
		Input	Output
LK410	46	16	0
LK411	46	16	0
LK414	38	16	0
LK415	36	12	0
LK430	36	12	0
LK440	46	16	0
LK441	49	16	0
LK510	21	0	8
LK511	22	4	8
LK610	2	2	0
LK611	2	2	0
LK612	2	2	0
LK613	1	2	0
LK614	1	2	0
LK615	1	2	0
LK630	2	124	2
LK710	5	2	2
LK711	4	1	1
LK712	4	1	1
LK720	3	1	1
LK810	35	8	4

Table 1.7: Different Data Packet Length and User Parameter (byte) for different modules

1.7 PLANNING, LAYOUT, AND INSTALLATION

After the planning and configuration requirements, as described in section 1.6, has been determined, you can proceed in planning the module installed on the backplane, its layout and installation requirements.

1.7.1 Installation Space and Allowance

During the installation of LK backplane, it is necessary to consider leaving enough space for heat dissipation and the ease of engineering aspect such as easy wiring, cabling and installation operation.

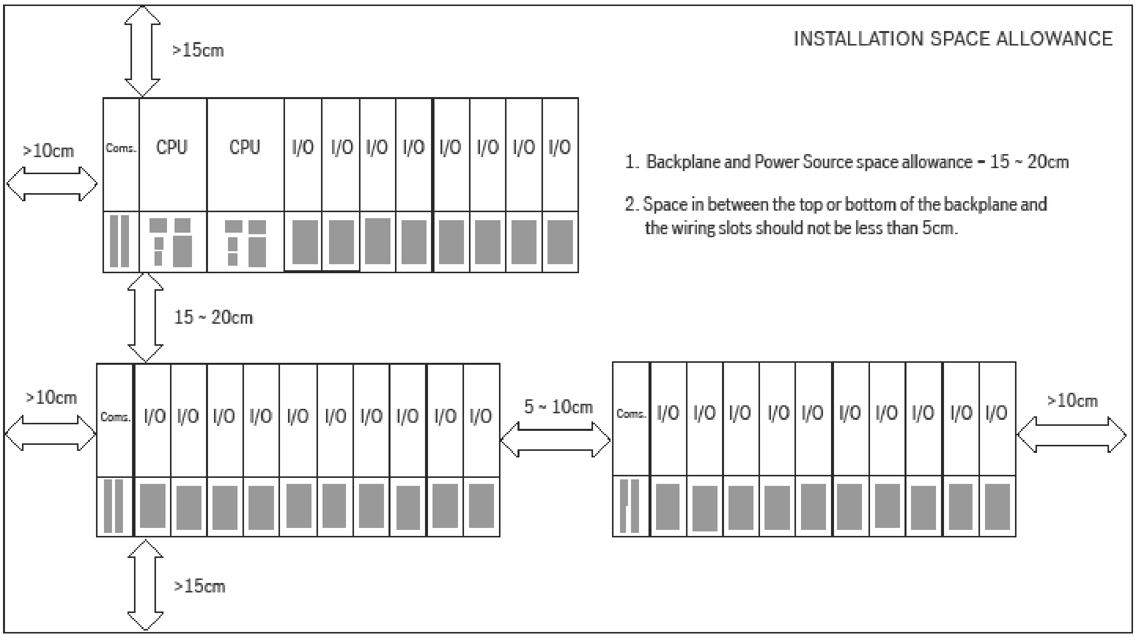


Figure 1.16: The Installation Space Allowance requirement for LK backplanes

1.7.2 Backplane Dimension

Except for the power supply, which is installed independently, all other LK hardware modules are installed on the backplane. The backplane is surface installed, with the two ends fixed on the installation surface using M4 screws. Various sizes (in mm unit) of backplane and installation are shown in Figure 1.17 and Figure 1.18. Besides the LK CPU controller width of 52.5mm, the rest of the modules are of the same width of 35mm. Hence, based on N number of I/O module:

- Single CPU local backplane: based on the centre distance of screw holes at both ends (35 + 52.5 + [35 x N] + 16.5) mm
- Dual CPU redundancy local backplane: based on the centre distance of screw holes at both ends (35 + 52.5 + 52.5 + [35 x N] + 16.5) mm
- Expansion backplane: based on the centre distance of screw holes at both ends (35 + [35 x N] + 16.5) mm

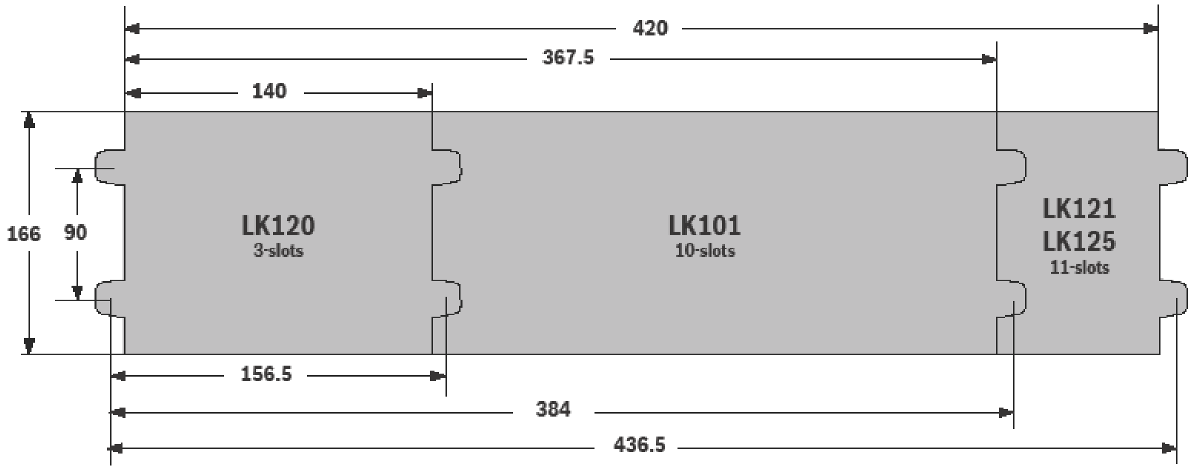


Figure 1.17: LK Local Backplanes and its Dimension

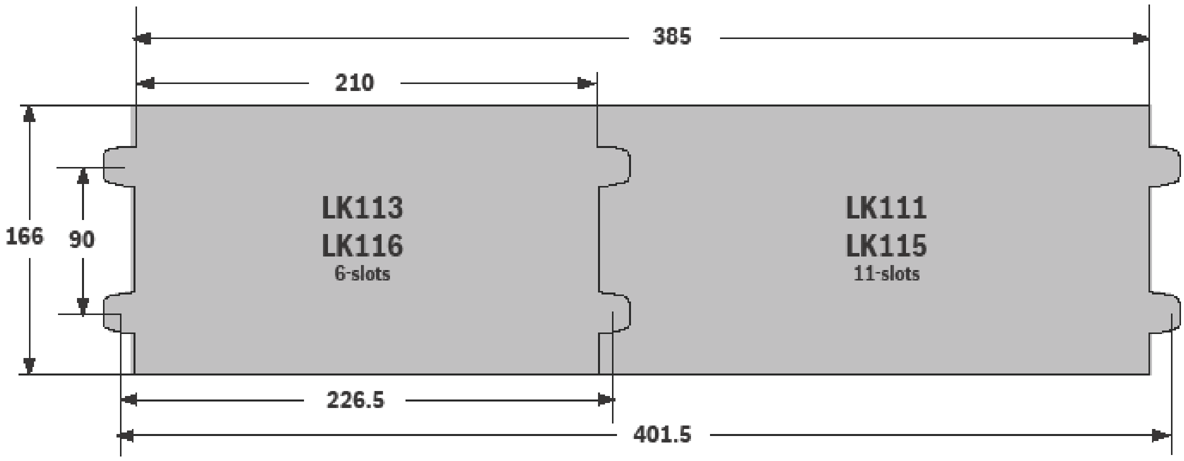
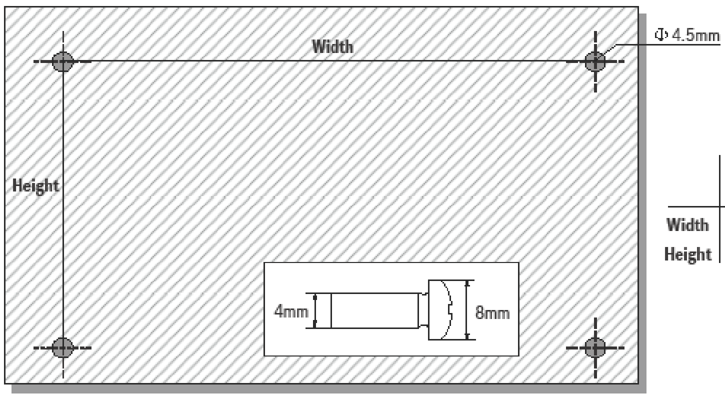


Figure 1.18: LK Expansion Backplanes and its Dimension

1.7.3 Backplane Mounting and Screws

LK backplanes are mounted on a flat surface. Both end of the backplane has a pair of mounting holes using M4 screw. A flat and smooth surface installation is required as shown in Figure 1.19.



	LK120	LK101	LK121 LK125	LK113 LK116	LK111 LK115
Width	156.5	384	436.5	226.5	401.5
Height	90	90	90	90	90

units:mm

Figure 1.19: Mounting Holes Dimension for LK backplane installation

1.7.4 Installation and Ventilation

The LK backplane are light, thin, and space-saving in design. Mounting and dismounting are very easy accomplished. It can be all installed in a centrally or distributed manner or even mounted directly onto the wall. The modules utilized a hook and latch snap-on for easy installation or optionally fastened a screw.

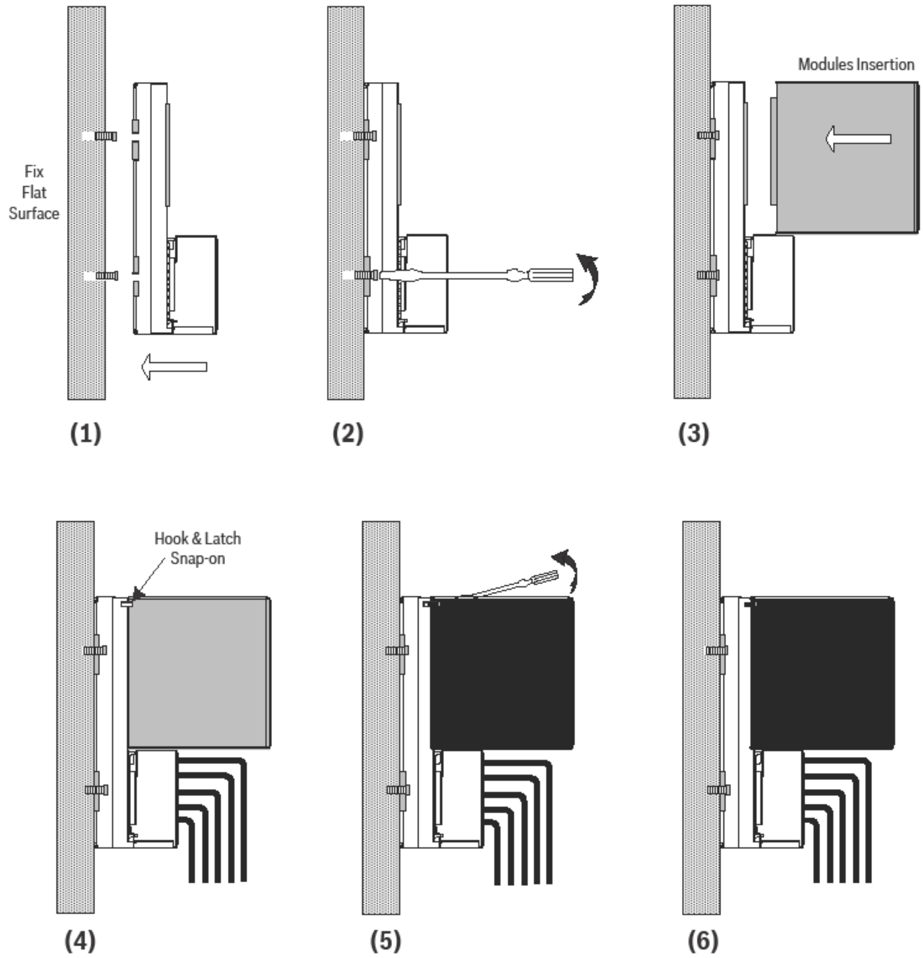


Figure 1.20: The LK Installation

The installation steps are as follows:

- Drill holes on the installation surface according to the distance between the mounting holes found on the backplane.
- Use M4 Philip screws and screw in two third of the threads, which keeps a gap in between the backplane.
- Align the backplane mounting holes with the screws and push the backplane down gently until the mounting holes and screws tightly matches before fastening the screws.
- Insert the module horizontally into the slot, and a clip sound will be heard if installed correctly.
- After the wiring and testing is completed with a working module, secure the module firmly with a M3 x 20mm screw.

Due to all the electrical equipment are continuously operating at high ambient temperature, a seriously though should be put into consideration on the temperature issue in order to reduced the equipment lifespan.

LK Series PLC uses only the conventional natural cooling methods without fan, hence the installation of the backplane and the PLC placement with sufficient space and allowance must be in placed ensure proper ventilation given to the LK PLC(s) and equipments.

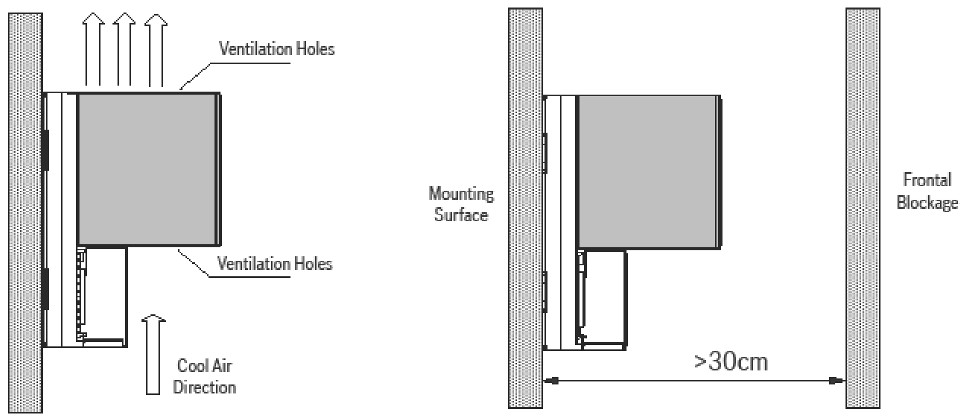


Figure 1.21: Proper Ventilation for the LK PLC

Avoid improper methods of installation which resulted in poor ventilation causing overheating of LK PLC.

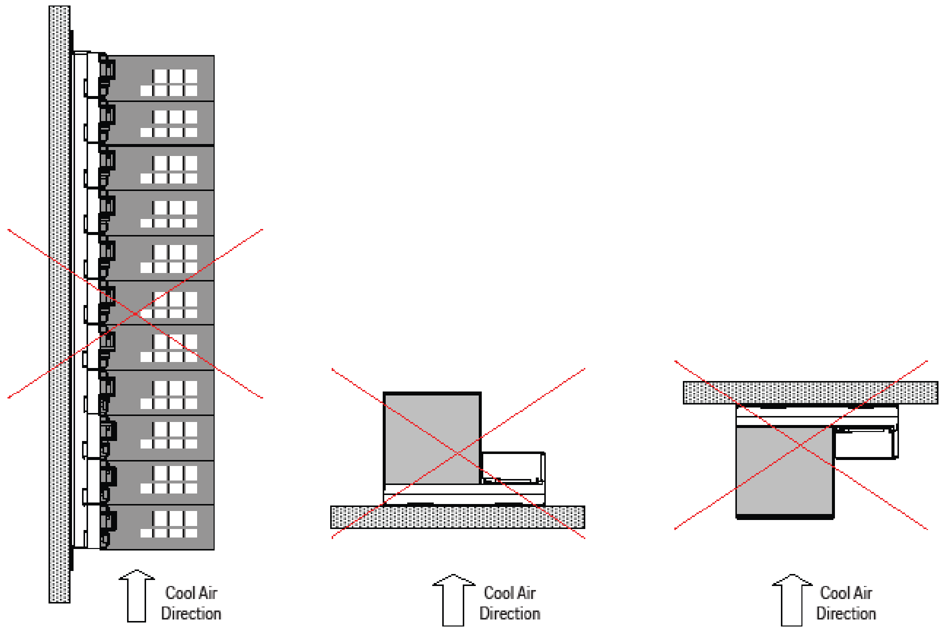


Figure 1.22: Improper Ventilation for the LK PLC

1.7.5 Module Insertion Mechanical Keys –To Prevent Incorrect Insertion

All the I/O modules are all designed with identical width and height with exception of the CPU modules. During a field maintenance work, a wrong insertion of an incorrect type of module will cause tremendous damage to the module, field devices, and other equipment connected to it. Thus every I/O modules and communication module are designed with a mechanical key to prevent any incorrect insertion of modules. The mechanical key is preset in such a way that it matches with the backplane's preset, thus allowing module insertion.

The mechanical key comprises of two sets of adjustable knobs. One set with setting of A to E, a total of 6 variations. The other set with setting of 0 to 5, a total of 6 variations. Thus, the total combination of this two sets results in a variation of 36 possible settings. (A0 to E5).

Besides the CPU controller, all other modules have a fixed preset of the mechanical keys. Each mechanical key preset on the module is factory defaulted in a fixed value and should not be altered. However, the mechanical keys on the backplane can be manually adjustable in order to match with the module requirement. It can be adjustable by hand but for proper engineering operation, a rotational tools for backplane's mechanical key is available, product code = LKF0003.

Please refer to Table 1.11 for a full listing of all the mechanical keys preset.

Based on LK414 as an example, this module's mechanical keys are factory preset as A1. Before inserting the modules onto the backplane, please check and adjust the two mechanical key knobs to A1. **Do not force a module into the backplane without confirming the mechanical key on the backplane as it will damage the module or backplane.**

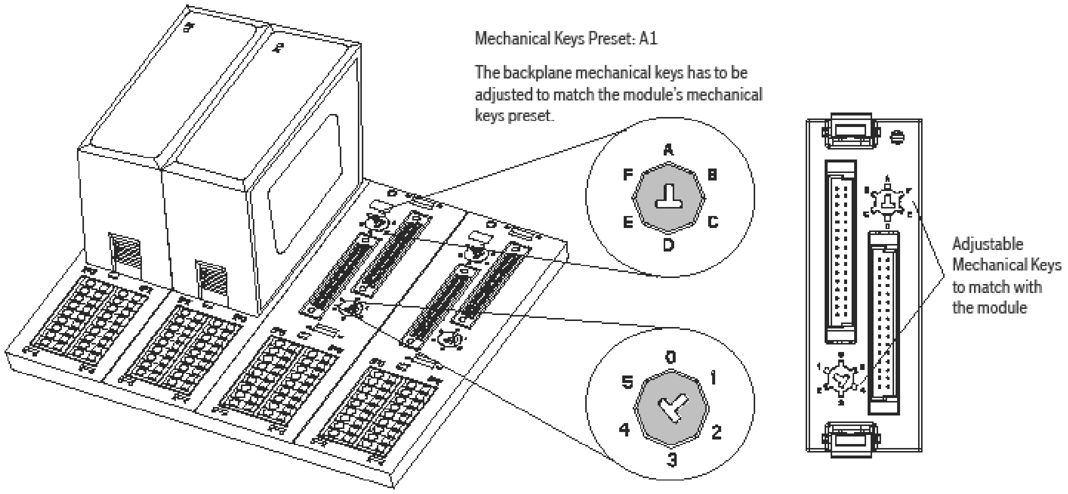


Figure 1.23: LK PLC- Mechanical Keys and Configuration

Upon a proper configuration of the mechanical keys on the backplane, please follow Figure 1.24 on how to insert or remove a module. Optionally, you can secure the module firmly onto the backplane by using a 20mm long M3 screw. During screwing, do not use too much force as damage can occurs on the module if the screwing torque is larger than 3~4kgf-cm.

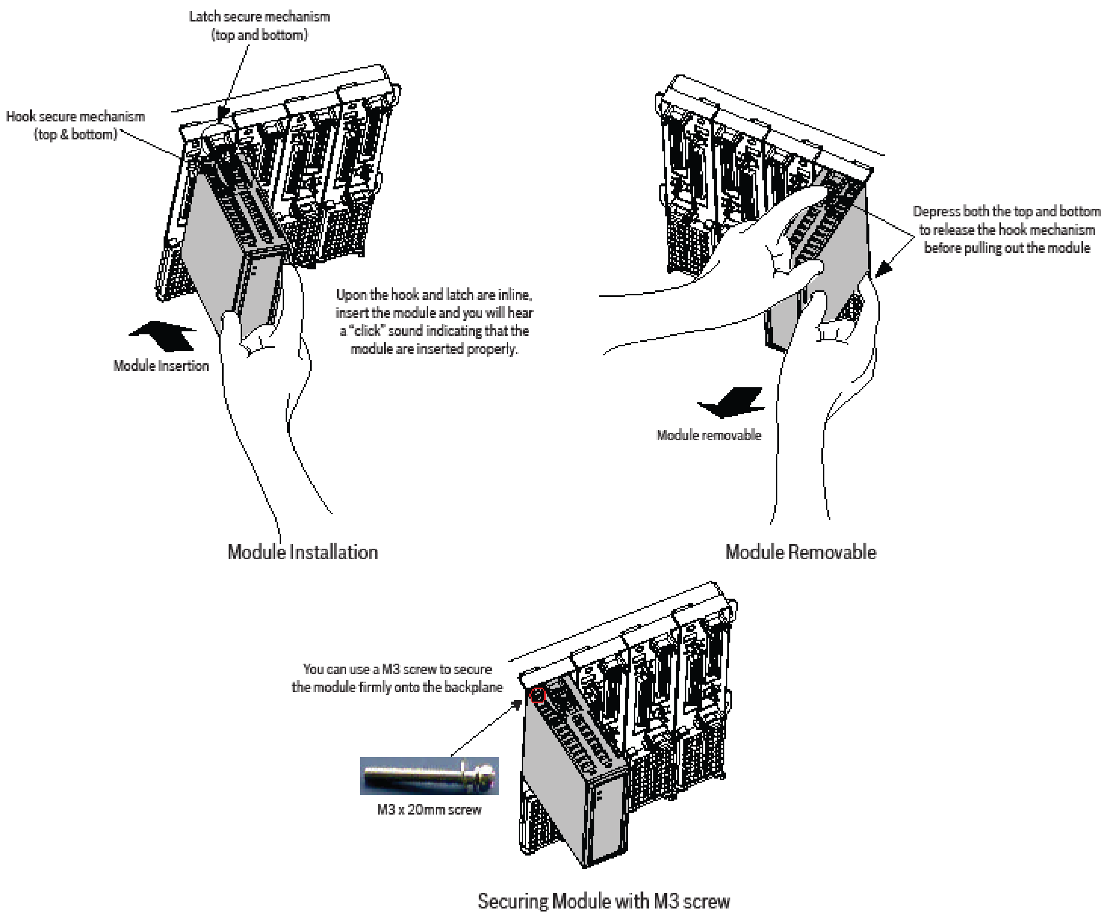


Figure 1.24: LK Module Insertion and Removable

1.8 SYSTEM WIRING

After the LK PLC Hardware is properly installed, you can start the system wiring. However, please take note of some of the requirement as follows:

1.8.1 PROFIBUS-DP Fieldbus Wiring

- The PROFIBUS-DP fieldbus wiring uses RS-485 twisted pair cables or optical fiber. From an engineering perspective and common application practice, the use of transmission medium is usually unshielded twisted pair. (Type A) The advantages are ease of construction, maintenance, economical, etc.
- The RS-485 twisted pair cable transmission medium selected can be of type A (STP) and type B(UTP). Type A is unshielded twisted pair and type B are ordinary twisted pair as shown in Table 1.8. Both have different bus cable characteristic. The impedance should be in between 100Ω to 165Ω, cable capacitance should be less than 60pF/m, and the conductor cross-sectional area greater than or equal to 0.22mm².

Cable Parameter	Type A	Type B
Impedance	135 ~ 165Ω	100 ~ 130Ω
Capacitance	< 30pF/m	< 60pF/m
Resistance	< 100Ω/km	Depends
Conductor cross-sectional area	>= 0.34mm^2 (22 AWG)	>=0.22mm^2 (24 AWG)

Table 1.8: Profibus-DP Cabling Specification

During the laying of cables, please pay attention to the following rules:

- Please do not twist, pull, or squeeze the cable
- For interior cable installation, it is necessary to comply with the basic constraints as shown in Table 1.9 (d = cable diameter)

Characteristic	Restriction
Single curve bending radius	>= 80mm (10 x d)
Multiple curve bending radius	>=160mm (20 x d)
Allowable Installation Temperature	0°C to 50°C
Allowable Operating Temperature	0°C ~ 60°C

Table 1.9: Interior Installation Restrictions for cabling

1.8.2 Total Cable Length and Restriction

- The cabling length (Maximum transmission distance) shall affect the transmission speed. Different media and baud rate will affect the reliability of the signal transmitted at what distance. Refer to Table 1.10 for more details. For a longer-distance communication, LK232 PROFIBUS-DP Bus Repeater can be use to extend the distance of the transmission signal. A maximum of 3 repeaters can be use in-between 2 nodes which will divided the bus into 4 sections.
- Besides increasing the network length, the Bus Repeater can also divide it into different segment providing electrical isolation in between the segment with different grounding.

	Transmission Rate	9.6Kbps, 19.2Kbps, 93.75Kbps	187.5Kbps	500Kbps	1500Kbps
Cable Type A	Range per segment	1200 meters	1000 meters	400 meters	200 meters
Cable Type B	Range per segment	1200 meters	600 meters	200 meters	70 meters

Table 1.10: Profibus-DP - Transmission Rate and Cabling Range for Type A and Type B

1.8.3 I/O Wiring Cable

The field I/O signal is divided into analog and digital signal.

- Analog Signal includes AI or AO signal. Such signals should use unshielded twisted pair cables.
- Digital Signal includes DI or DO signal. For low-level digital signal, unshielded twisted pair cable connection can be used. For high-level (or high current) digital input and output signals, unshielded twisted-pair cable connection can also be used but it should be individually running cabling and separated from the other analog or digital signals.

When used for process control application, the field I/O signal should be laid on a dedicated cable trunking with a good proper grounding and cover. Appropriate selection of cable with proper shielding should be used. Common grounding should be provided at the controller device side of the system (system ground).

1.8.4 Preparation of I/O Cables

- *For terminals on the backplane:*
  - Backplane terminals pin hole diameter of 5mm/0.197inches
  - Can adapt to the cable diameter AWG28 ~ AWG12/0.08 ~ 3.33mm²
  - Cable strip-off length is 8 ~ 9mm/0.33inches
- *For terminals on the terminal block:*

- Terminal Block can adapt to cable diameter AWG24 ~ AWG12/0.2 ~ 3.33mm^2
- Cable strip-off length is 8mm/0.33inches

➢ *I/O cables are prepared based on:*

- The I/O module type and wiring to devices to determine the signal and the corresponding terminal relations.
- The signal type to determine the type of cable required.
- The location of the field devices to determine the cable length.

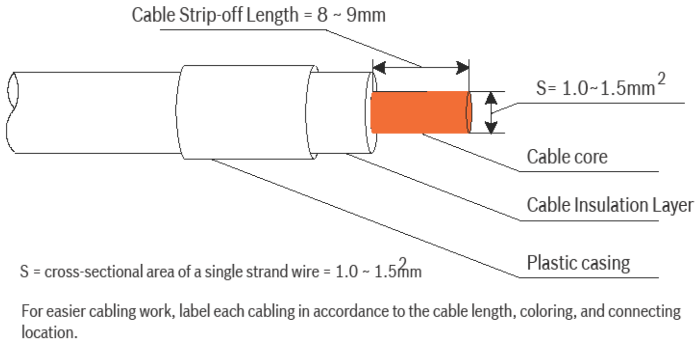


Figure 1.25: The Preparation of I/O Cables

I/O Cables and Terminal Connection

Spring-cage I/O terminal (Pressure clip terminals) allow more convenient wiring method as compared with traditional screw terminals. The I/O terminals points are located on the backplane in the space area below the module. It uses 18 points (2 vertical rows) of new double stress spring-cage I/O terminals. As compared to the traditional screw-type terminal wiring, this is much easier and convenient to use.

➢ Connect the cable to the terminal as follows:

- Use a suitable screwdriver, press vertically into the square hole found on the right side of the terminal point so that the circular hole in the left side of the terminal opens.
- Insert the prepared I/O cable wiring into the terminal point (the opened circular hole on the terminal). The wiring will be 'snap-on' immediately when you remove the screwdriver.
- Check if the wring are made appropriately and do not leave any naked wiring (cable core) outside the terminal point to avoid any dangerous short-circuit. If the cable strip-off length are prepare appropriately (8~9mm), it should not leave any cable core outside the terminal point.

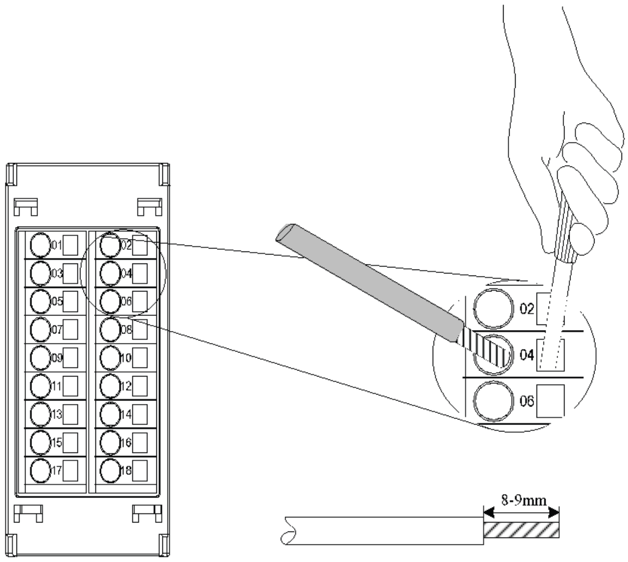


Figure 1.26: Connecting the I/O cables onto the terminal points

For backplanes that does not have the build-in terminal points but extended out via the prefabricated terminal cabling to each terminal blocks, please refer to Chapter 12: Terminal Module on how to make the wiring.

1.9 GROUNDING REQUIREMENTS

Before the PLC hardware modules are powered on for testing, the complete installation of the system grounding must be made and tested. Under normal circumstances, there is a grounding protection of the main grounding for the system and shield grounding for signal transmission.

- **Main Equipment Grounding**: A protection mechanism to prevent and avoid personal injury to the operator from the accumulation of electrostatic charge.
- **Shield Grounding**: The removal or reduction of interference on the transmission signal in order to improve signal quality. Analog signals shielded cable requires proper grounding provided on the PLC system grounding, the backplane grounding, and the PROFIBUS-DP cable shield grounding.

A dedicated grounding must be provided for the PLC alone. PLC grounding should not be grounded indirectly through other equipment grounding. The grounding cable diameter needs to be as large as possible. Generally, the minimum diameter should not be less than 2.5mm (10AWG) with a grounding resistance of less than 4 ohms.

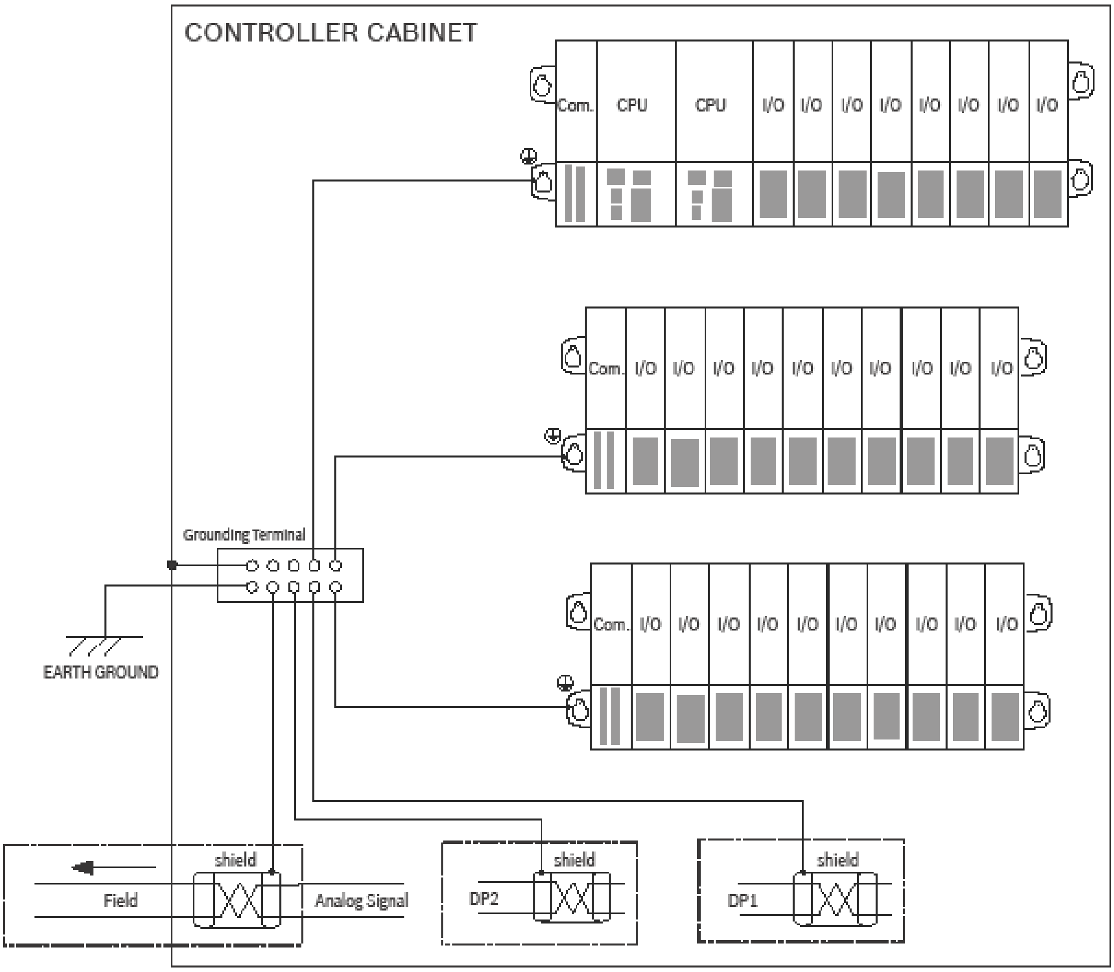


Figure 1.27: System Grounding Requirement for LK PLC

1.10 LK MODULE AND ITS MECHANICAL KEY CODE

Module Type	Model	Description	Mechanical Key Code
Local Backplanes (Terminal type)	LK101	10 Slots Local Backplane - Single CPU slot, 367.5 x 166 x 117mm (WxHxD)	None
	LK120	3 Slots Local Backplane - Redundancy CPU (2 slots), 140 x 166 x 117mm (WxHxD)	None
	LK121	11 slots Local Backplane - Redundancy CPU (2 slots), 420 x 166 x 117mm (WxHxD)	None
Local Backplanes (Prefabricated I/O cable type)	LK125	11 slots Local Backplane - Redundancy CPU (2 slots), 420 x 166 x 117mm (WxHxD)	None
Expansion Backplanes (Terminal type)	LK111	11 slots Expansion Backplane, 385 x 166 x 117mm (WxHxD)	None
	LK113	6 slots Expansion Backplane, 210 x 166 x 117mm (WxHxD)	None
Expansion Backplanes (Prefabricated I/O cable type)	LK115	11 slots Expansion Backplane, 385 x 166 x 117mm (WxHxD)	None
	LK116	6 slots Expansion Backplane, 210 x 166 x 117mm (WxHxD)	None
Terminals Block for I/O	LK3310	Standard I/O Terminal Block (36 terminal pins), for use with LK115, LK116, LK125	None
CPU Module	LK207	533Mhz, speed=0.013µs per step, program: 16MB, data: 64MB+1MB power-loss zone, for single CPU slot backplane.	None
	LK210	533Mhz, speed=0.013µs per step, program: 16MB, data: 64MB+1MB power-loss zone, SRAM, for redundancy CPU slots backplane.	None
Communication Modules	LK231	PROFIBUS-DP communication interface module with DP Termination Matching Resistor (Enable/Disable)	A5
	LK232	PROFIBUS-DP Bus Repeater Module with DP Termination Matching Resistor (Enable/Disable)	A5
	LK250	PROFIBUS-DP Network Extension Module with DP Termination Matching Resistor (Enable/Disable)	B5
	LK252	PROFIBUS-DP + MODBUS Master Module	C5
AI Module	LK410	8-channels AI Module, voltage input, (±10V/0~5V/0~10V)	A0
	LK411	8-channels AI Module, current input, (0~20mA/4~20mA)	A1
	LK414	8-channels AI Module, current input, (4~20mA)	A1
	LK415	6-channels AI Module, voltage/current input, (0~20mA/4~20mA/±10V/0~5V/0~10V)	A0
	LK430	6-channels AI Module, RTD, (PT100/200/500/1000, Ni 100/120/200/500, Cu 10/50)	A2
	LK440	8-channels AI Module, thermocouple, (B/C/E/J/K/N/R/S/T type, -12mV~+32mV or +78mV)	B1
	LK441	8-channels AI Module thermocouple with cold junction compensation, (B/C/E/J/K/N/R/S/T type, -12mV~+32mV or +78mV)	B1
AO Module	LK510	4-channels AO Module, voltage output (±10V/0~5V/0~10V)	C0
	LK511	4-channels AO Module, current output (0~21mA/4~20mA)	C1
AI+AO Module	LK810	4-channels AI / 2-channels AO Module	F0
	LK850	4-channels AI / 2-channels AO Module, HIGHSPEED	F0
DI Module	LK610	16-channels DI Module, 24VDC, sink	D0
	LK611	16-channels DI Module, 24VDC, source	D0
	LK612	16-channels DI Module, 48VDC, source	D1
	LK613	16-channels DI Module, 24VAC	D2
	LK614	16-channels DI Module, 120VAC	A3
	LK615	16-channels DI Module, 220VAC	A4

	LK650	16-channels DI Module, 24VDC, sink, HIGHSPEED	D0
	LK651	16-channels DI Module, 24VDC, source, HIGHSPEED	D0
	LK652	16-channels DI Module, 48VDC, source, HIGHSPEED	D1
DO Module	LK710	16-channels DO Module, Transistor MOSFET, 0.5A per channel, 10 ~30VDC	E0
	LK711	8-channels DO Module, TRIAC, 0.5A per channel, 10~60VAC	E1
	LK712	8-channels DO Module, TRIAC, 1A per channel, 74~265VAC	B4
	LK720	8-channels DO Module, Normally Open Relay, 2A, 10~265VAC/5~125VDC	D3
	LK750	16-channels DO Module, Transistor MOSFET, 0.5A per channel, 10 ~ 30VDC, HIGHSPEED	E0
Special Functions	LK630	16-channels DI Module, 12/24VDC, sink, SOE	D0
	LK680	2-channels counter module, HIGHSPEED	F2
Power Supply	LK910	Power Supply, input 120/230VAC, output: 24VDC, 5A, 120Watts	NONE

Table 1.11: LK Product List and Mechanical Key Code

Hollysys are constantly designing or upgrading new additional modules which will be informed and made available by official note. Please consult Hollysys for the latest updates on product listing.

1.11 PRODUCT STORAGE AND SHIPPING

1.11.1 Storage Requirements

- Storage Temperature: 0 to +40℃
- Relative Humidity: 40% to 80%, non-condensing, no corrosive gas
- Storage area should not contain any forms of corrosive gas, flammable, explosive, etc.
- Storage area should not have any strong mechanical vibration, shock, or magnetic field.
- Packaging box from the ground not less than 100mm
- At least 500m away from the distance walls, heat and cold source

1.11.2 Shipping Requirements

- The packaging box should not be affected by rain, snow, corrosive liquid and mechanical damage. For long-distance transportation, it should be place inside proper ship or transportation cabin. It should not be stored in open warehouses during transit.
- Packaging box should be able to withstand shock, vibration, or collision.
- LK Product and Weight. *Refer to Table 1.12.*

Model	Description	Weight (g)
LK101	10 Slots Local Backplane - Single CPU slot, 367.5 x 166 x 117mm (WxHxD)	1360g
LK120	3 Slots Local Backplane - Redundancy CPU (2 slots), 140 x 166 x 117mm (WxHxD)	610g
LK121	11 slots Local Backplane - Redundancy CPU (2 slots), 420 x 166 x 117mm (WxHxD)	1940g
LK125	11 slots Local Backplane - Redundancy CPU (2 slots), 420 x 166 x 117mm (WxHxD)	1780g
LK111	11 slots Expansion Backplane, 385 x 166 x 117mm (WxHxD)	1740g
LK113	6 slots Expansion Backplane, 210 x 166 x 117mm (WxHxD)	880g
LK115	11 slots Expansion Backplane, 385 x 166 x 117mm (WxHxD)	1630g
LK116	6 slots Expansion Backplane, 210 x 166 x 117mm (WxHxD)	925g
LK207	Single CPU controller	280g
LK210	Redundancy CPU controller	280g
LK231	PROFIBUS-DP communication interface module	170g
LK232	PROFIBUS-DP Bus Repeater Module	170g
LK250	PROFIBUS-DP Network Expansion Module	170g
LK252	PROFIBUS-DP + MODBUS Master Module	170g
LK410	8-channels AI Module, voltage input	190g
LK411	8-channels AI Module, current input	190g
LK414	8-channels AI Module, current input	190g
LK415	6-channels AI Module, voltage/current input	190g
LK430	6-channels AI Module, RTD input	180g
LK440	8-channels AI Module, thermocouple input	180g
LK441	8-channels AI Module thermocouple with cold junction compensation	180g
LK510	4-channels AO Module, voltage output	180g
LK511	4-channels AO Module, current output	180g
LK810	4-channels AI / 2-channels AO Module	180g
LK850	4-channels AI / 2-channels AO Module, HIGHSPEED	180g
LK610	16-channels DI Module, 24VDC, sink	180g
LK611	16-channels DI Module, 24VDC, source	180g
LK612	16-channels DI Module, 48VDC, source	180g
LK613	16-channels DI Module, 24VAC	180g
LK614	16-channels DI Module, 120VAC	180g
LK615	16-channels DI Module, 220VAC	180g
LK650	16-channels DI Module, 24VDC, sink, HIGHSPEED	185g
LK651	16-channels DI Module, 24VDC, source, HIGHSPEED	185g
LK652	16-channels DI Module, 48VDC, source, HIGHSPEED	185g
LK710	16-channels DO Module, Transistor MOSFET, 10 ~30VDC	180g
LK711	8-channels DO Module, TRIAC, 10~60VAC	200g
LK712	8-channels DO Module, TRIAC, 74~265VAC	180g
LK720	8-channels DO Module, Normally Open Relay, 10~265VAC/5~125VDC	210g
LK750	16-channels DO Module, Transistor MOSFET, 10 ~ 30VDC, HIGHSPEED	185g
LK630	16-channels DI Module, 12/24VDC, sink, SOE	195g
LK680	2-channels counter module, HIGHSPEED	185g
LK910	Power Supply, input 120/230VAC, output: 24VDC, 5A, 120Watts	790g

Table 1.12: LK Modules and Weight

Chapter

2

CHAPTER 2: BACKPLANES

2.1 INTRODUCTION

The LK backplanes consist of the local backplane and its expansion backplane. The local backplane is used to install the communication module, the CPU controller module, and the I/O modules. Through the expansion backplane connected cascading; further I/O modules can be installed to expand the system I/Os. Each expansion backplane also has a communication module running in slave mode.

Two types of local backplane are available. LK121 and LK120 support redundancy CPU controllers while LK101 supports only a single CPU controller.

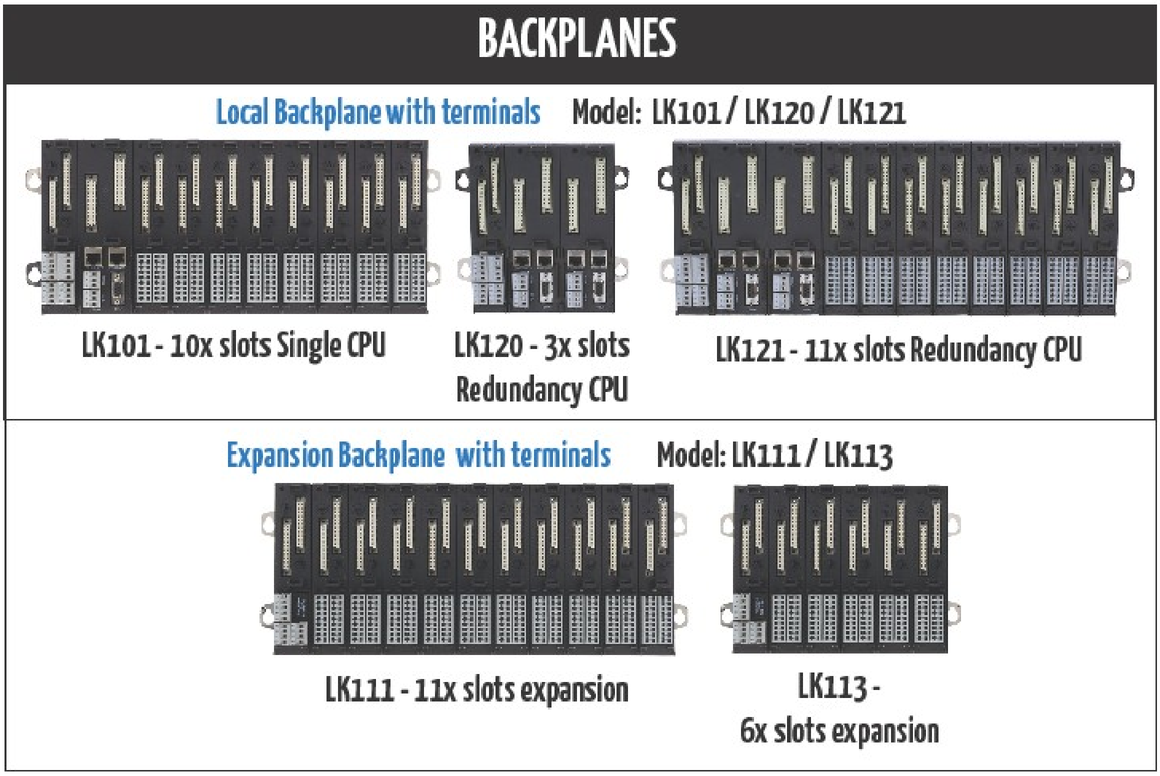


Figure 2.1: Backplane with terminal points

2.2 EXTERNAL INTERFACES OF THE LK LOCAL BACKPLANE

The External interfaces found on the LK Local Backplane provides data communication with the external devices.

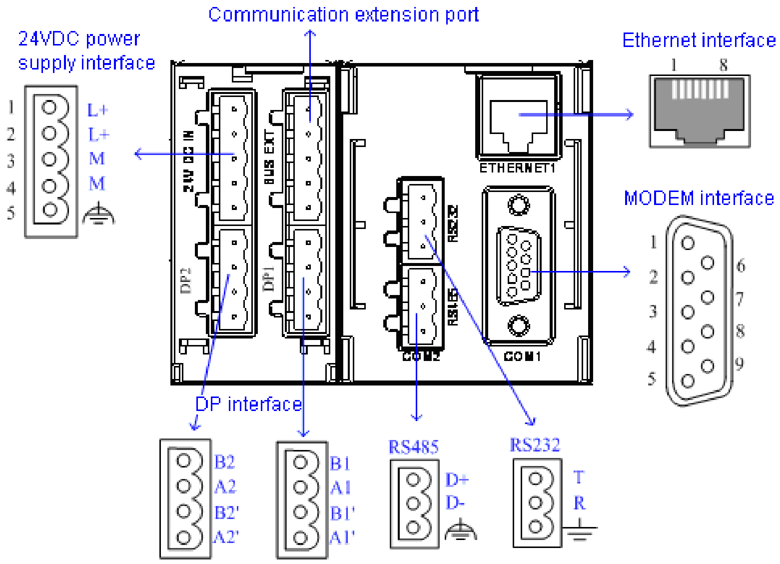


Figure 2.2: External Interfaces of LK101 Backplane

2.2.1 ProfiBus-DP Interface

LK PROFIBUS-DP with redundancy design is made in accordance with the international standards, IEC61158-3 and EN50170 supporting baud rates from 9.6Kbps to 1.5Mbps.

The DP-bus found on the local backplane is used for all local I/O modules and CPU controller communication.

With an additional of a communication module, the DP-bus can be expanded to provide data communication between the CPU controller and all the I/O modules on the expansion backplane(s). This expansion is made possible using these sets of PROFIBUS-DP 4 pins interface, DP1 and DP2.

The pin's signal definitions of PROFIBUS-DP interface is shown in the table below:

Pin No.	Pin Label		Signal
	DP1	DP2	
1	B1	B2	Nil
2	A1	A2	Nil
3	B1′	B2′	DP+ (Red)
4	A1′	A2′	DP- (Green)

Table 2.1: Signal Definition of Profibus-DP interface

PROFIBUS-DP redundancy are achieve by connecting using DP1 and DP2 sockets found on the local backplane with correspondence with DP1 and DP2 sockets on the expansion backplane.

For better EMC protection, it is recommended to use the **Type-A Profibus-DP cables** (shielded twisted-pair) for connections which meet the Profibus-DP standards. For a well-proof EMC environment (within the range of 50m or less), Type-B Profibus-DP cables (unshielded twisted-pair) can also be used.

Please refer to Chapter 4: Communication Modules for more detail information.

2.2.2 COM2: RS-485 or RS-232 interface

COM2 serial port supports RS-232 or RS-485 uses two 3-pin connectors. COM2 can only be set as either RS-232 or RS-485 communication port (that is, only one of the 3-pin sockets can be used), which is selected by PowerPro programming software configuration. The default setting for COM2 is the RS232 interface.

COM2 communication configuration parameter function block "HS_SetParameter_COM2" can be called from the communication library, "HS_Communication.Lib". Please refer to the LK Instruction Reference Manual for further detail information on how to use this function block.

Pin No.	RS232		RS485	
	Pin Label	Signal	Pin Label	Signal
1	T	TXD (send data)	D+	485+
2	R	RXD (receive data)	D-	485-
3		RS232 ground reference		RS485 cable analog grounding

Table 2.2: Signal Definition of COM2: RS-485 or RS-232 Interface

The COM2 serial port of LK207 supports RS232 and RS485. Its output is located at the bottom left corner and utilizes two 3-pin connectors. Through programming software, COM2 can be configure at one time as either RS232 or RS485 port (in other word, only one of the two 3-pin sockets can be used at one time).

2.2.3 COM1: MODEM interface

COM1 is a standard MODEM interface that uses a DB9 connector.

Pin No.	Signal Name	Signal
1	DCD	Data carrier detect
2	RXD	Receive data
3	TXD	Transmit data
4	DTR	Data terminal ready
5	GND	Serial port ground
6	DSR	Data set ready
7	RTS	Request to send
8	CTS	Clear to send
9	Nil	Nil

Table 2.3: Signal Definition of COM1: Modem Interface

2.2.4 Ethernet interface

The Ethernet interface uses a standard RJ-45 interface sockets.

Pin No.	Signal Name	Cable Colour	Signal
1	TxData+	White-Orange	Data Transmitting +
2	TxData-	Orange	Data Transmitting -
3	RecvData+	White-Green	Data Recieving +
4	NC	Blue	Nil
5	NC	White-Blue	Nil
6	RecvData-	Green	Data Receiving -
7	NC	White-Brown	Nil
8	NC	Brown	Nil

Table 2.4: Signal Definition of Ethernet Interface

2.2.5 24VDC power supply interface

Power supply for all the hardware modules found on the local backplane is provided via the 24VDC power supply interface.

Pin No.	Pin Label	Signal
1	L+	24V+
2	L+	24V+
3	M	GND
4	M	GND
5		Analog grounding

Table 2.5: Signal Definition of 24VDC power supply interface

2.2.6 Communication extension port

Communication extension ports are functions provided by the communication control module on the left of the backplane, which support multiple communication protocols.

Please refer to Chapter 4: Communication Modules for more detail information.

2.3 DATA BUS OF LOCAL BACKPLANE

The local backplane supports both high-speed backplane bus and redundant DP bus, as shown in Figure 2.3, Figure 2.4, and Figure 2.5.

- The high-speed bus is used only by the high-speed I/O module with one end of the terminal resistance (TR) ending at the backplane and the other ending at the communication module.
- The Redundant DP bus used by normal I/O module with one end of the TR ending at the backplane and the other ending at the communication module.
- Within each communication module, a DP output interface is available providing I/O expansion connected serially to another expansion backplane. More expansion backplane can be cascaded in this way. TR is set at the last communication module.

Please refer to Chapter 4: Communication Modules for more detail information.

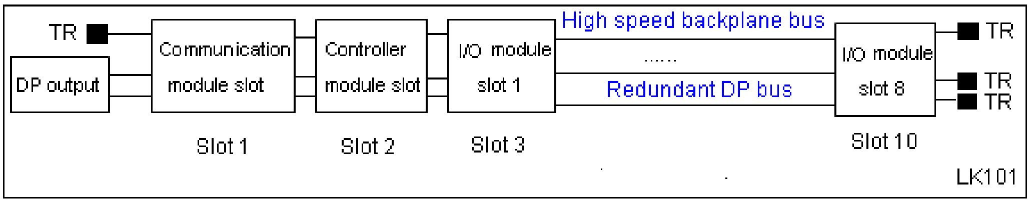


Figure 2.3: Internal Data Bus of the LK101 local backplane

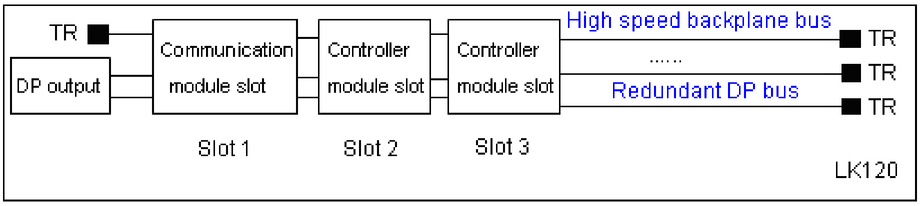


Figure 2.4: Internal data bus of LK120 local backplane

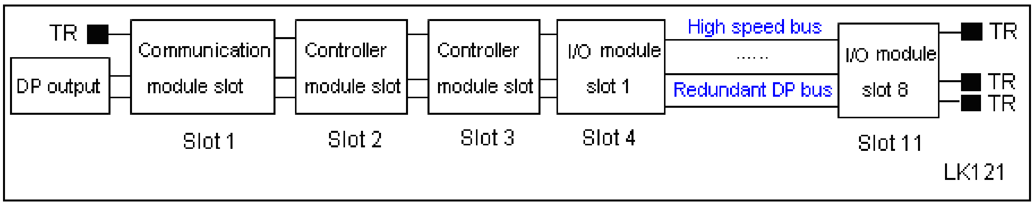


Figure 2.5: Internal data bus of LK121 local backplane

2.4 COMMUNICATION ADDRESS

The communication address, also referred to as the station address or station number, is the identifier of each communication node (controller or I/O module) in the communication link.

Controller IP address

The communication between controllers and upper layer of the control network requires IP addresses to be specified. The first three bytes of the IP address are specified by PowerPro software, and the last byte is specified by the two switches on the controller panel, which is also referred to as the communication address of the controller.

The first 3 bytes of the IP addresses of controllers can be changed by calling the HS_SetIPAddress function block from the external library HS_SetIPAddress.Lib.

The range of the communication addresses of controllers is from 10 to 99. For example, when the ten position (x 10) is switched to 1, and unit position (x 1) is switched to 0, the communication address of the controller will be "10".

Please note that the communication addresses for two redundant controllers must be the same.

2.4.1 I/O module communication addresses

The communication between I/O modules and controllers requires communication addresses to be specified. The communication addresses of the I/O modules on the local backplane are determined by their locations on the backplane, and cannot be modified. Once the installation locations are fixed, so are the communication addresses.

As shown in Figure 2.6 and Figure 2.7, eight I/O modules can be installed on the local backplane, with communication address starting from 2, 3, and so on till 9.

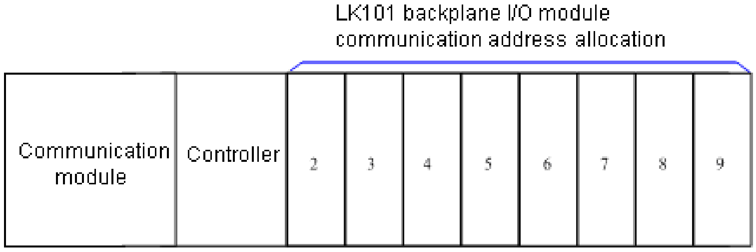


Figure 2.6: Allocation of Communication address of the I/O modules on the LK101 backplane

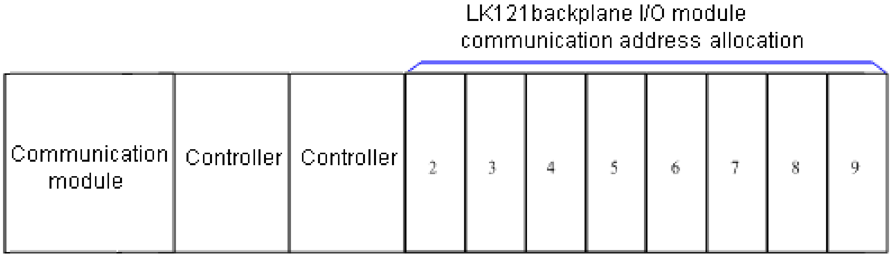


Figure 2.7: Allocation of Communication address of the I/O modules on LK121 backplane

2.5 INTERRUPTS

The controller and the high-speed module on the local backplane exchange data through the high-speed data bus. The controller allocates different sizes of shared memory to store the input and output data of the high-speed module. The field input signals can be configured as interrupts to the controller and interrupt the application for quick respond.

As shown in Figure 2.8, only the first four I/O slots after the controller, namely, station number 2 to 5, can support interrupts. High speed modules with interrupt enabled must be installed in one of these first four slots.

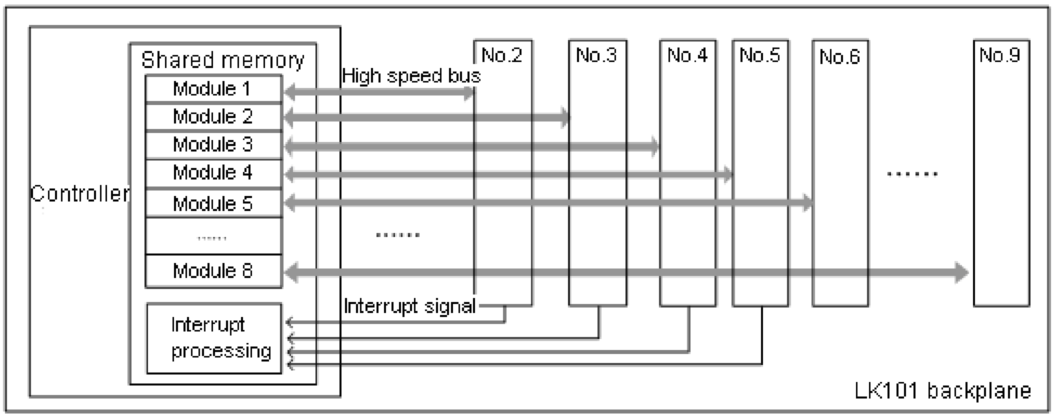


Figure 2.8: Interrupt Response on the LK101 / LK121 Backplane

2.6 LK101 [10 SLOT SINGLE CPU LOCAL BACKPLANE]

2.6.1 Features

- 1 communication slot + 1 controller slot + 8 I/O slots
- Redundant ProfiBus-DP interface
- 24VDC system power input
- Extended serial ports: RS232/RS485/MODEM
- Spring-cage I/O terminal wiring points
- Support 32Mbps high speed local bus
- Ethernet interface
- Module insertion mechanical key preventing incorrect module insertion

LK101 is a 10 slot single CPU local backplane with spring-cage I/O terminal wiring points at the frontal of the backplane, as shown in Figure 2.9:

- First slot from the left is the communication module slot reserved for the PROFIBUS-DP communication or other special communication. LK231, LK232, LK252
- The second slot for Single CPU controller module, LK207.
- Slots 3 to 10 are I/O module slots, where either high speed I/O modules or normal I/O modules can be installed.
- Each terminal base corresponds to an I/O module, which connects directly to the field devices via I/O cables.
- The PROFIBUS-DP communication interface is connected to the expansion backplane.
- Extended series ports are connected to external devices.

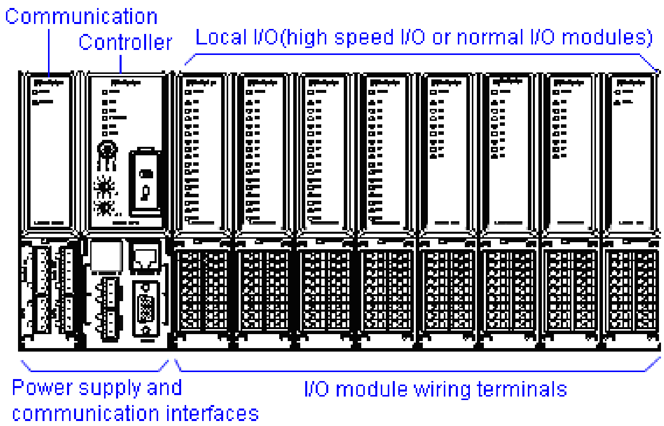


Figure 2.9: Frontal view of LK101 Backplane and Controller

2.6.2 Dimension

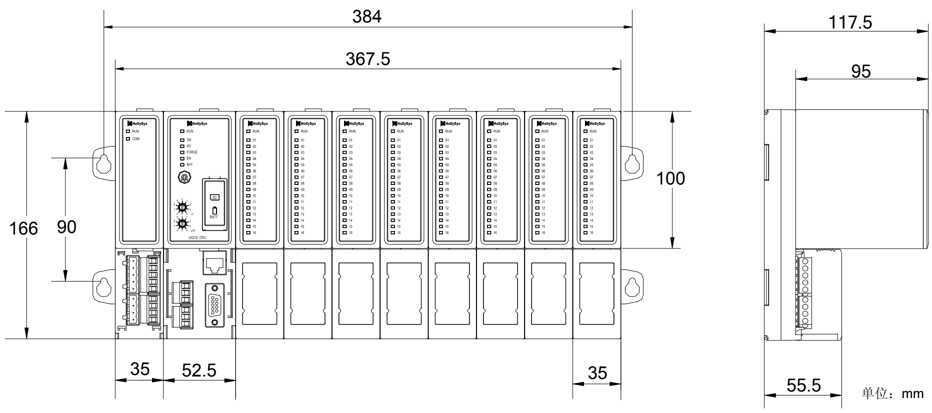


Figure 2.10: LK101 Backplane and its dimension

- LK101: The horizontal distance between the centers of the screws on both sides will be (35+52.5+35x8+16.5)mm = 384mm
- LK101: The vertical distance between the centers of the screws on the same side will be 90mm

2.6.3 Technical Specification

LK101 [10-slot single CPU local backplane]	
Slots and interfaces	
Number of slots	10 slots (1 communication slot, 1 controller slot, and 8 I/O slots)
Interrupt input slot	4 slots, next to the 4 I/O slots of the controller
Ethernet interface	RJ45 with LEDs
COM1 serial port	DB9 socket
COM2 serial port	3 pin socket, either RS485 or RS232
ProfiBus-DP interface	4 pin socket, double sockets
Communication extension port	5 pin socket, defined by the communication extension module.
System power supply	5 pin socket, 24V DC system power supply
Isolation Voltage	
Channel to channel	≥1000VAC@1min.， current leakage 5mA
Channel to system	≥1000VAC@1min.， current leakage 5mA
Electrical specifications	
Input Voltage	24VDC (-15%~+20%)
Bus termination resistance	One end fixed, active matching
Physical features	
Installation method	Surface installation
Dimensions	Width x height x depth = 367.5mm×166mm×55.5mm
Casing protection level	IEC60529 IP20
Weight	1360g
Working Environment	
Working temperature	0°C~60°C
Working relative humidity	10%~95%, no condensate
Storage temperature	-40°C~70°C
Storage relative humidity	5%~95%, no condensate

Table 2.6: Technical Specification of LK101 Backplane

For details on wiring, cable processing, installation, drilling, layout and grounding, please refer to section 1.7 in chapter 1 on Planning, Layout, and Installation at page 27.

2.7 LK120 [3-SLOT DUAL CPU LOCAL BACKPLANE]

2.7.1 Features

- 1 communication + 2x redundant controller slots
- Redundant ProfiBus-DP interface
- Redundant Ethernet interface
- Extended serial ports: RS232/RS485/MODEM
- Spring-cage I/O terminal wiring points
- Support 32Mbps high-speed local bus
- 24VDC system power input

LK120 is a 3-slot dual CPU local backplane, as shown in Figure 2.11.

- First slot from the left is reserved for the communication module.
- The second and the third slots are for installing the redundant CPU controllers. The controller installed in the second slot is Controller B, and the controller installed in the third slot is Controller A.
- Typically, Controller A is the primary machine and Controller B is the secondary machine.
- Communication interface is connected to an external device or an expansion backplane.

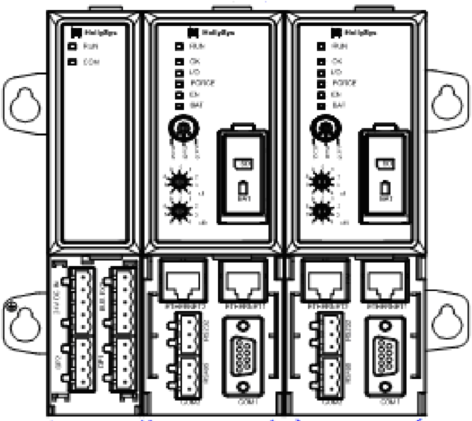


Figure 2.11: The Frontal View of LK120 backplane

2.7.2 Dimension

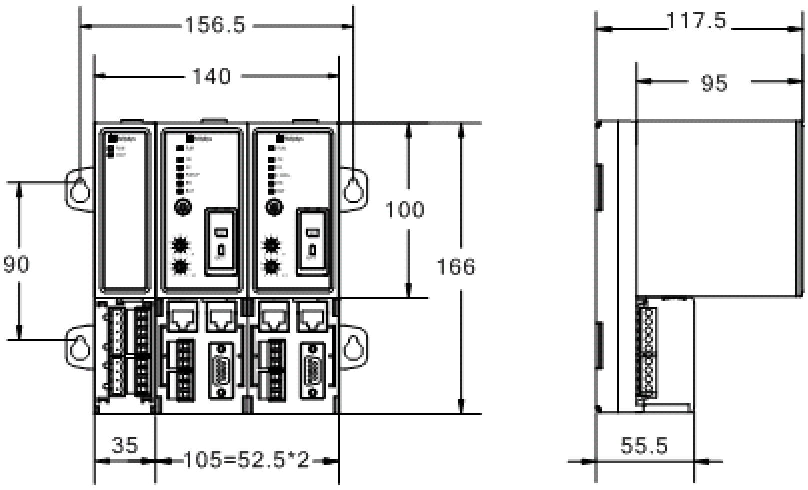


Figure 2.12: LK120 Backplane and its dimension

- LK120: The horizontal distance between the centers of the screws on both sides will be (35+52.5x2+16.5)mm = 156.5mm
- LK120: The vertical distance between the centers of the screws on the same side will be 90mm

2.7.3 Technical Specifications

LK120 [3-slot Dual CPU local backplane]	
Slots and interfaces	
Number of slots	3 slots (1 communication slot and 2 controller slots)
Ethernet interface	4 RJ45 with LED
COM1 serial port	DB9 socket
COM2 serial port	3 pin socket, either RS485 or RS232
ProfiBus-DP interface	4 pin socket, double sockets
Communication extension port	5 pin socket, defined by the communication extension module.
System power supply	5 pin socket, 24V DC system power supply
Isolation Voltage	
Channel to channel	≥1000VAC@1min,.current leakage 5mA
Channel to system	≥1000VAC@1min,.current leakage 5mA
Electrical specification	
Input Voltage	24VDC (-15% ~ 20%)
Bus termination resistance	One end fixed, active matching
Physical feature	
Installation method	Surface installation
Dimension	Width x height x depth = 140mm×166mm×55.5mm
Casing protection level	IEC60529 IP20
Weight	610g
Working Environment	
Working temperature	0℃~60℃
Working relative humidity	10%~95%, no condensate
Storage temperature	-40℃~70℃
Storage relative humidity	5%~95%, no condensate

Figure 2.13: Technical Specification of LK120 Local Backplane

For details on wiring, cable processing, installation, drilling, layout and grounding, please refer to section 1.7 in chapter 1 on Planning, Layout, and Installation at page 27.

2.8 LK121 [11-SLOT DUAL CPU LOCAL BACKPLANE]

2.8.1 Features

- 1 communication slot + 2 redundant controller slots + 8 I/O slots
- Redundant ProfiBus-DP interface
- 24VDC working power input
- Support controller redundancy configuration
- Extended serial ports: RS232/RS485/MODEM
- Spring-cage I/O terminal wiring points
- Support 32Mbps high speed local bus
- Module insertion mechanical key preventing incorrect module insertion

LK121 is an 11-slot dual CPU local backplane as shown in Figure 2.14.

- First slot from the left is reserved for the communication module.
- Typically, Controller A is the primary machine and Controller B is the secondary machine.
- The second and the third slots are for installing the redundant CPU controllers. The controller installed in the second slot is Controller B, and the controller installed in the third slot is Controller A.
- Slots 4 to 11 are I/O module slots, where either high-speed or normal I/O modules can be installed.
- Communication interface is connected to an external device or an expansion backplane.

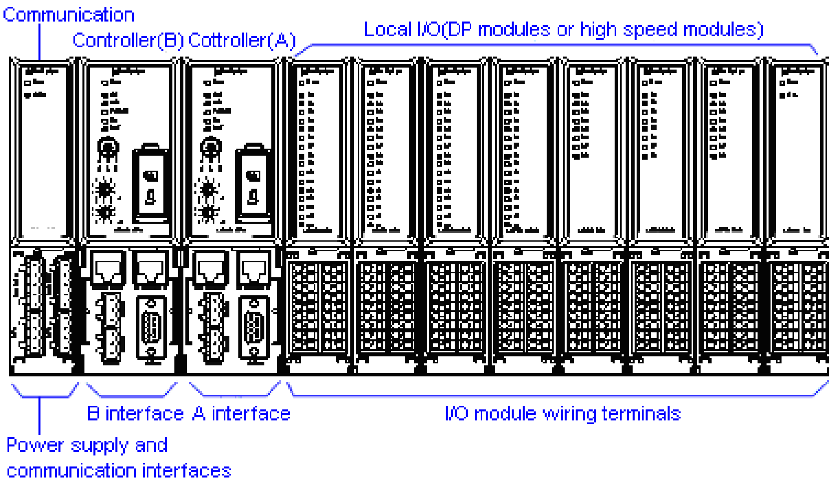


Figure 2.14: The Frontal View of LK121 backplane

2.8.2 Dimension

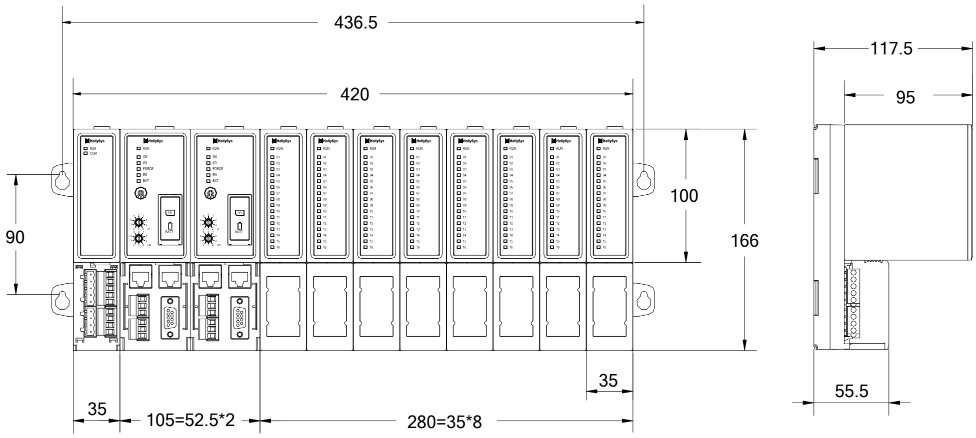


Figure 2.15: LK121 Backplane and its dimension

- LK121: The horizontal distance between the centers of the screws on both sides will be (35+52.5x2+35x8+16.5)mm = 436.5mm
- LK121: The vertical distance between the centers of the screws on the same side will be 90mm <0}

2.8.3 Technical Specifications

LK121 [11-slot Dual CPU local backplane]	
Slots and interfaces	
Number of slots	11 slots (1 communication slot, 2 controller slots, and 8 I/O slots)
Interrupt input slot	4 slots, next to the 4 I/O slots of the controller
Ethernet interface	RJ45 with LEDs
COM1 serial port	DB9 socket
COM2 serial port	3 pin socket, either RS485 or RS232
ProfiBus-DP interface	4 pin socket, double socket
Communication extension port	5 pin socket, defined by the communication extension module.
System power supply	5 pin socket, 24V DC system power supply
Isolation Voltage	
Channel to channel	≥1000VAC@1min.， current leakage 5mA
Channel to system	≥1000VAC@1min.， current leakage 5mA
Electrical specifications	
Input Voltage	24VDC (-15% ~ 20%)
Termination resistance	One end fixed, active matching
Physical features	
Installation method	Surface installation
Dimensions	Width x height x depth = 420mm×166mm×55.5mm
Casing protection level	IEC60529 IP20
Weight	1940g
Working Environment	
Working temperature	0℃~60℃
Working relative humidity	10%~95%, no condensate
Storage temperature	-40℃~70℃
Storage relative humidity	5%~95%, no condensate

Table 2.7: Technical Specification of LK121 Local Backplane

For details on wiring, cable processing, installation, drilling, layout and grounding, please refer to section 1.7 in chapter 1 on Planning, Layout, and Installation at page 27.

2.9 LK111 [11-SLOT EXPANSION BACKPLANE]

2.9.1 Features

- 1 communication slot and 10 I/O slots
- Redundant ProfiBus-DP interface
- 24VDC working power input
-
- Dip switch from station base address
- Support cascading of expansion backplanes
- Spring-cage I/O terminal wiring points
- Module insertion mechanical key preventing incorrect module insertion

LK111 is an 11-slot dual CPU local backplane as shown in Figure 2.16.

- First slot from the left is reserved for the communication module.
- Slots 2 to 11 are I/O module slots, which are used to install normal I/O modules with DP bus interfaces.
- High speed I/O modules **CANNOT** be installed on the expansion backplane.
- Each terminal base corresponds to an I/O module, which directly connects to field signals via I/O cables.

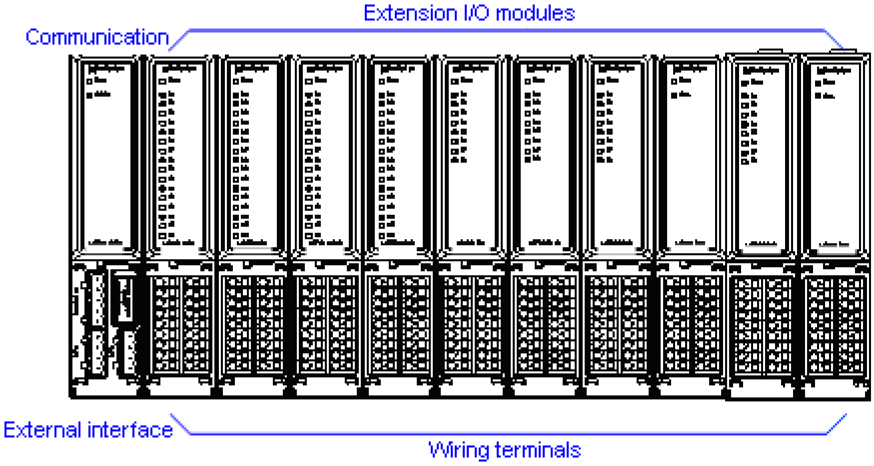


Figure 2.16: The Frontal View of LK111 backplane

2.9.2 Data Bus of the Expansion Backplane

As shown in Figure 2.17 the expansion backplane supports redundant DP bus.

- The DP bus input and DP bus output interfaces are available on the expansion backplane.
- DP input is connected from the local backplane or expansion backplane.
- DP out can be further connected to another expansion backplane.
- The expansion backplane does not provide the matching termination resistance for the DP bus.
- TR is provided by the communication module.

Please refer to Chapter 4: Communication Modules for more detail information in regards to TR.

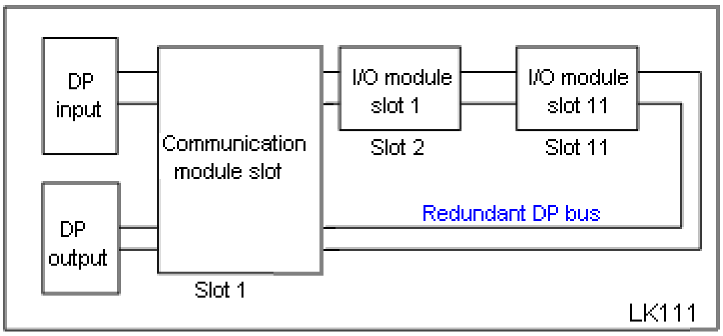


Figure 2.17: Data bus of LK111 Expansion Backplane

2.9.3 Interface Specifications

The I/O modules on the expansion backplane communicate and exchange data with the controller on the local backplane through the ProfiBus-DP interfaces link.

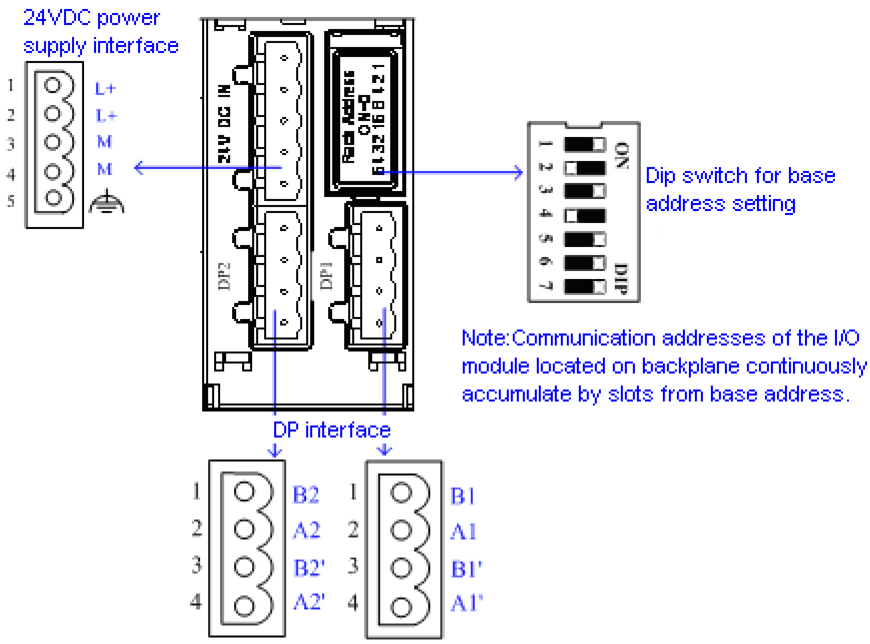


Figure 2.18: Power supply and communication interfaces of LK111 backplane

ProfiBus-DP Interface

The DP bus interface on the LK111 expansion backplane is used for communications between the controller and the I/O modules on the expansion backplanes.

Pin No.	Pin Label		Signal
	DP1	DP2	
1	B1	B2	DP IN+
2	A1	A2	DP IN-
3	B1′	B2′	DP OUT+
4	A1′	A2′	DP OUT-

Table 2.8: Signal definitions of the DP connector for LK111 expansion backplane

24VDC power supply interface

The 24VDC working power supply for the hardware modules on the LK111 backplane is connected from the power supply interface on the backplane.

Pin No.	Pin Label	Signal
1	L+	24V+
2	L+	24V+
3	M	GND
4	M	GND
5	⏚	Analog grounding

Table 2.9: Signal definitions of the Power Supply Connector for LK111 expansion backplane

2.9.4 Communication address

The communication addresses of I/O modules are formed by "Backplane base address + backplane offset address".

The base address is the communication address of the first I/O module from the left, which is configured by the seven digit dip switch on the backplane. The offset addresses from the second to the tenth I/O modules are 1~9 respectively.

Note: when multiple backplanes are cascaded, do not set duplicate communication addresses.

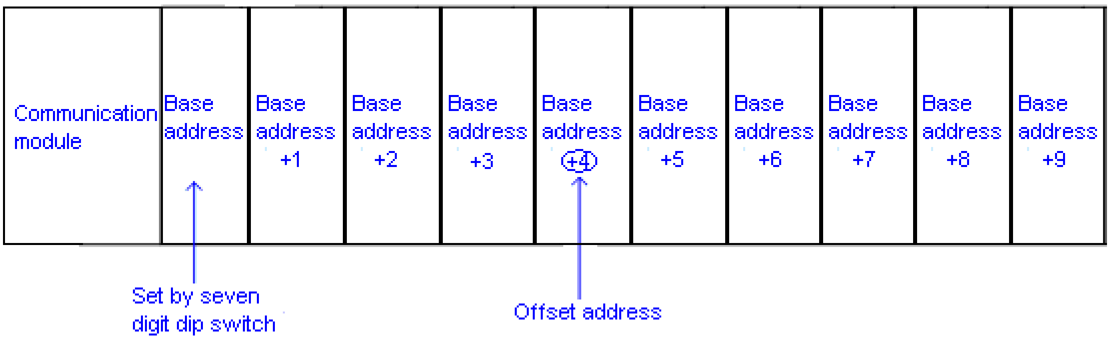


Figure 2.19: Allocation of communication addresses of the I/O modules on LK111 backplane

As shown in Figure 2.20, when a digit of the dip switch is set to "ON", this digit is 0, and when it is switched towards the numbers, the digit is 1. The seven digits from high to low form a binary number, whose corresponding decimal number is the base address of the backplane.

The conversion formula is as below:

Base address = 64xK7 + 32xK6 + 16xK5 + 8xK4 + 4xK3 + 2xK2 + 1xK1

Wherein: Ki (i=1~7) represents the i-th digit in the dip switch.

For example: the dip switch digits from high to low are "0001010", the corresponding decimal number "10" is the base address of the backplane, and the communication addresses of the I/O modules on the LK111 backplane will be 10, 11, …, 18 and 19 respectively.

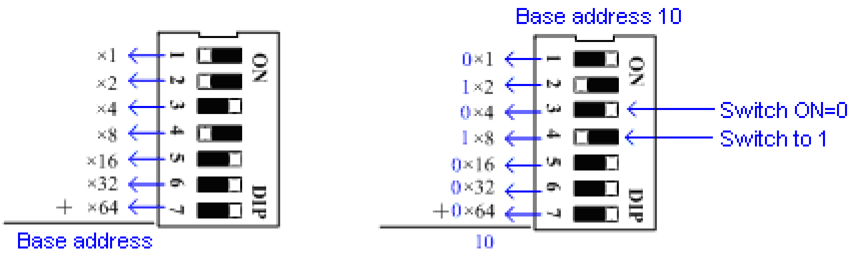


Figure 2.20: Base address settings on LK111 backplane

2.9.5 Dimensions

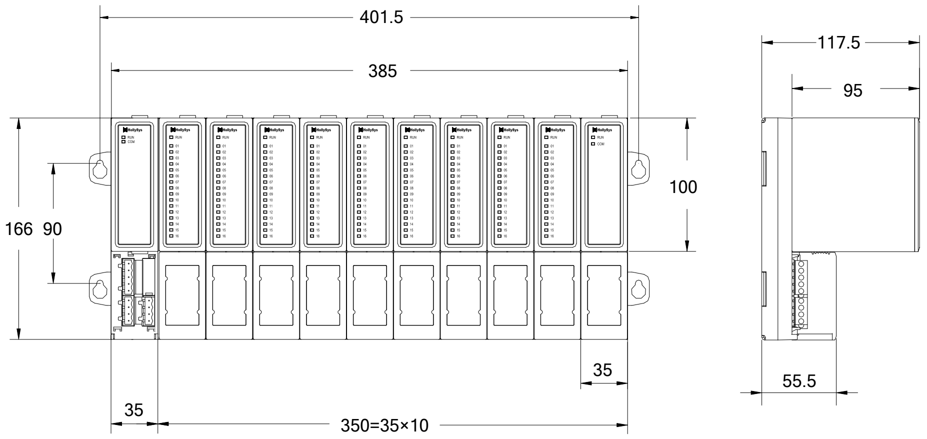


Figure 2.21: LK111 Backplane and its dimension

- LK111: The horizontal distance between the centers of the screws on both sides will be (35x11+16.5)mm = 401.5mm
- LK111: The vertical distance between the centers of the screws on the same side will be 90mm <0}

2.9.6 Technical Specifications

LK111 11 slot expansion backplane	
Slots and interfaces	
Number of slots	11 slots (1 communication port and 10 I/O slots)
ProfiBus-DP interface	4 pin socket, double sockets
System power supply	5 pin socket, 24V DC system power supply
Isolation Voltage	
Channel to channel	≥1000VAC@1min.， current leakage 5mA
Channel to system	≥1000VAC@1min.， current leakage 5mA
Electrical specifications	
Input Voltage	24VDC (-15% ~ 20%)
Termination resistance	N/A. May be provided by the communication module.
Physical features	
Installation method	Surface installation
Dimensions	Width x height x depth = 385mm×166mm×55.5mm
Casing protection level	IEC60529 IP20
Weight	1740g
Working Environment	
Working temperature	0°C～60°C
Working relative humidity	5%~95%, non-condensing
Storage temperature	-40°C～70°C
Storage relative humidity	5%~95%, non-condensing

Table 2.10: Technical Specification of LK111

For details on wiring, cable processing, installation, drilling, layout and grounding, please refer to section 1.7 in chapter 1 on Planning, Layout, and Installation at page 27.

2.10 LK113 [6- SLOT EXPANSION BACKPLANE]

2.10.1 Features

- 1 communication port and 5 I/O slots
- Redundant ProfiBus-DP interface
- 24VDC working power input
- Spring-cage I/O terminal wiring points
- Dip switch from station base address
- Module insertion mechanical key preventing incorrect module insertion

LK113 is a 6-slot expansion backplane as shown in Figure 2.22.

- First slot from the left is reserved for the communication module.
- Slots 2 to 6 are I/O module slots, which are used to install normal I/O modules with DP bus interfaces.
- High speed I/O modules **CANNOT** be installed on the expansion backplane.
- Each terminal base corresponds to an I/O module, which directly connects to field signals via I/O cables.

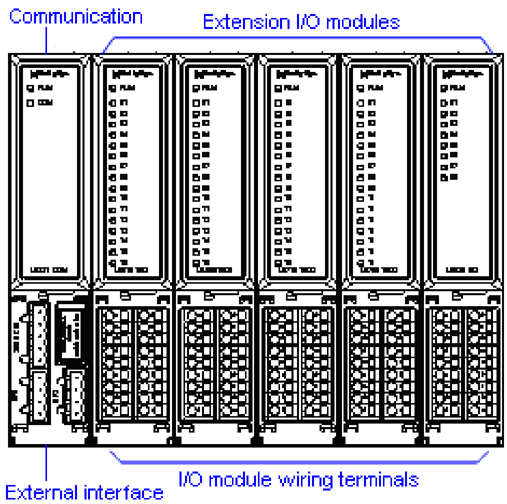


Figure 2.22: The Frontal View of LK113 backplane

2.10.2 Data Bus of the Expansion Backplane

As shown in Figure 2.23, the expansion backplane supports redundant DP bus.

- The DP bus input (DPIN) and DP bus output (DPOUT) interfaces are available on the expansion backplane.
- DP input is connected from the local backplane or expansion backplane.
- DP out can be further connected to another expansion backplane.
- The expansion backplane does not provide the matching termination resistance for the DP bus.
- TR is provided by the communication module.

Please refer to Chapter 4: Communication Modules for more detail information in regards to TR.

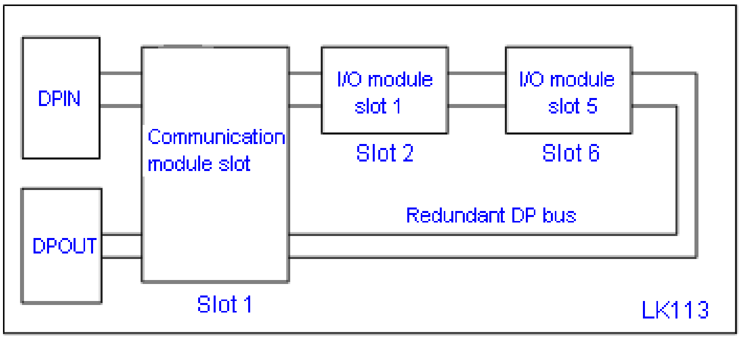


Figure 2.23: Data bus of LK113 Expansion Backplane

2.10.3 Interface Specifications

The I/O modules on the expansion backplane communicate and exchange data with the controller on the local backplane through the ProfiBus-DP interfaces.

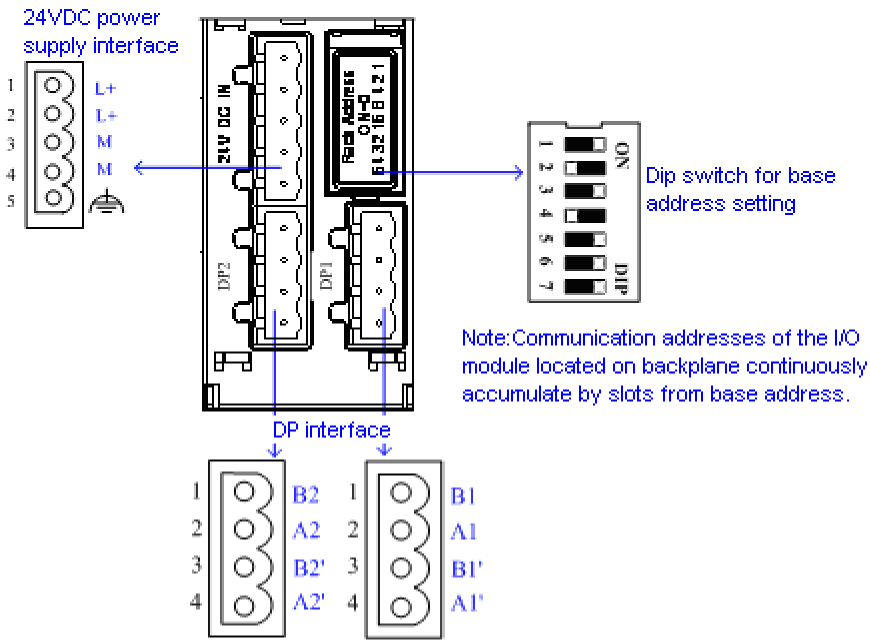


Figure 2.24: Power supply and communication interfaces of LK113 backplane

ProfiBus-DP Interface

The DP bus interface on the LK113 expansion backplane is used for communications between the controller and the I/O modules on the expansion backplanes.

Pin No.	Pin Label		Signal
	DP1	DP2	
1	B1	B2	DPIN+
2	A1	A2	DPIN-
3	B1′	B2′	DPOUT+
4	A1′	A2′	DPOUT-

Table 2.11: Signal definitions of the DP connector for LK113 expansion backplane

24VDC power supply interface

The 24VDC working power supply for the hardware modules on the LK113 backplane is connected from the power supply interface on the backplane.

Pin No.	Pin Label	Signal
1	L+	24V+
2	L+	24V+
3	M	GND
4	M	GND
5	⏚	Analog grounding

Table 2.12: Signal definitions of the Power Supply Connector for LK113 expansion backplane

2.10.4 Communication address

The communication addresses of I/O modules are formed by “Backplane base address + backplane offset address”.

The base address is the communication address of the first I/O module from the left, which is configured by the seven digit dip switch on the backplane. The offset addresses from the second to the fifth I/O modules are 1~4 respectively, as shown in Figure 2.25.

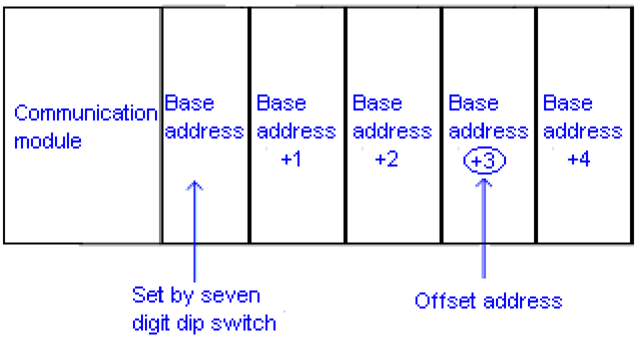


Figure 2.25: Allocation of communication addresses of the I/O modules on LK113 backplane

When a digit of the dip switch is set to "ON", this digit is 0, and when it is switched towards the numbers, the digit is 1. The seven digits from high to low form a binary number, whose corresponding decimal number is the base address of the backplane.

The conversion formula is as below:

Base address = 64xK7 + 32xK6 + 16xK5 + 8xK4 + 4xK3 + 2xK2 + 1xK1

Wherein: Ki (i=1~7) represents the i-th digit in the dip switch.

For example: the dip switch digits from high to low are "0001010", the corresponding decimal number "10" is the base address of the backplane, and the communication addresses of the I/O modules on the LK113 backplane will be 10, 11, 12, 13 and 14 respectively.

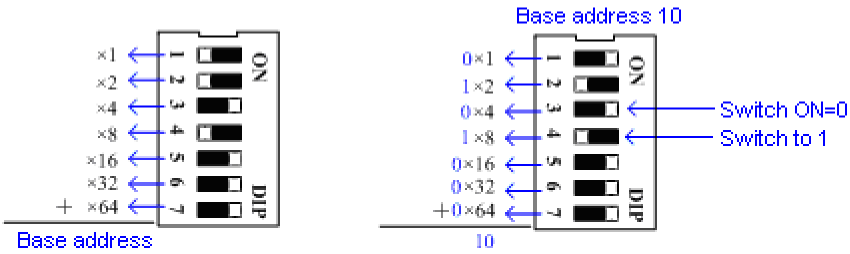


Figure 2.26: Base address settings on LK113 backplane

When multiple backplanes are cascaded, do not set duplicate communication addresses.

2.10.5 Dimensions

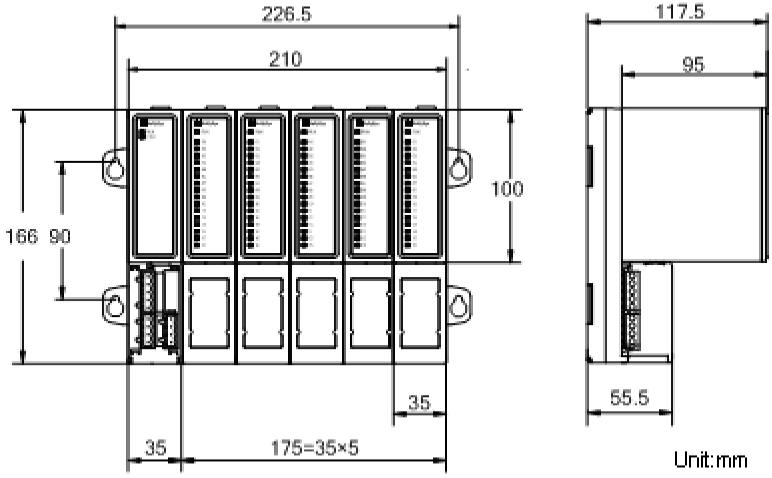


Figure 2.27: LK113 Backplane and its dimension

- LK113: The horizontal distance between the centers of the screws on both sides will be (35x35x5+16.5)mm = 226.5mm
- LK113: The vertical distance between the centers of the screws on the same side will be 90mm

2.10.6 Technical Specifications

LK113 [6-slot expansion backplane]	
Slots and interfaces	
Number of slots	6 slots (1 communication port and 5 I/O slots)
ProfiBus-DP interface	4 pin socket, double sockets
System power supply	5 pin socket, 24V DC system power supply
Isolation Voltage	
Channel to channel	≥1000VAC@1min.， current leakage 5mA
Channel to system	≥1000VAC@1min.， current leakage 5mA
Electrical specifications	
Input Voltage	24VDC±10%
Termination resistance	N/A. May be provided by the communication module.
Physical features	
Installation method	Surface installation
Dimensions	Width x height x depth = 210mm×166mm×55.5mm
Casing protection level	IEC60529 IP20
Weight	880g
Working Environment	
Working temperature	0℃～60℃
Working relative humidity	5%~95%, non-condensing
Storage temperature	-40℃～70℃
Storage relative humidity	5%~95%, non-condensing

Table 2.13: Technical Specification of LK113

For details on wiring, cable processing, installation, drilling, layout and grounding, please refer to section 1.7 in chapter 1 on Planning, Layout, and Installation at page 27.

2.11 LK125 [11-SLOT DUAL CPU LOCAL BACKPLANE]

PREFABRICATED CABLING TO TERMINAL BLOCK

LK125 is similar to LK121 except for the DB25 interface (different methods of I/O interconnected to terminal blocks via pre-fabricated cabling. Field devices are connected to the terminal blocks instead).

2.11.1 Features

- 1 communication slot + 2 redundant controller slots + 8 I/O slots
- Redundant ProfiBus-DP interface
- 24VDC working power supply interface
- Extended serial ports: RS232/RS485/MODEM
- Frontal interface for prefabricated cabling to terminal block
- Support 32Mbps high speed local bus
- Redundant Ethernet interface
- Module insertion mechanical key preventing incorrect module insertion

LK125 is an 11 slot double CPU local backplane, where prefabricated cables are connected to onsite signals from the front. As shown in figure 7.7.1, the first slot from the left is the communication module slot, which is used to install LK special communication modules. The second slot and the third slot are the redundant controller module slots for redundant controllers. Slots 4 to 11 are I/O module slots, where either high speed I/O modules or normal I/O modules can be installed. It is recommended that high speed I/O modules should be installed first, then normal I/O modules.

Each DB25 cable base corresponds to an I/O module, and is connected to a special terminal module through a prefabricated cable. Each communication interface is connected to an external device or an expansion backplane.

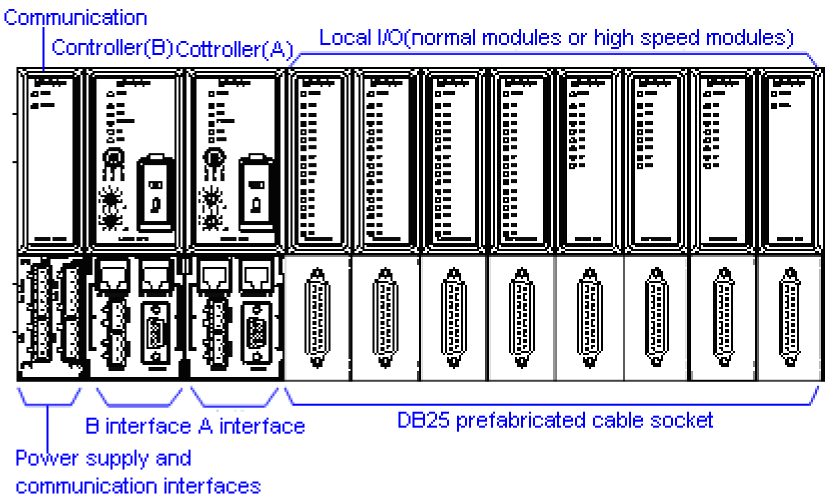


Figure 2.28: The Frontal View of LK125 backplane

2.11.2 Interface

All other interface are similar to LK121, please refer to the interface specification section on 2.2 at page 39 for more details.

DB25 socket

Used for onsite wiring. One end of the prefabricated cable is connected to the DB25 socket, and the other end is connected to the DB25 socket of a terminal module.

Material code	Model	Specification
3080000062	LKX005	3.0m
3080000063	LKX004	2.0m
3080000064	LKX003	1.2m

Table 2.14: DB25 Prefabricated cables

2.11.3 Dimensions

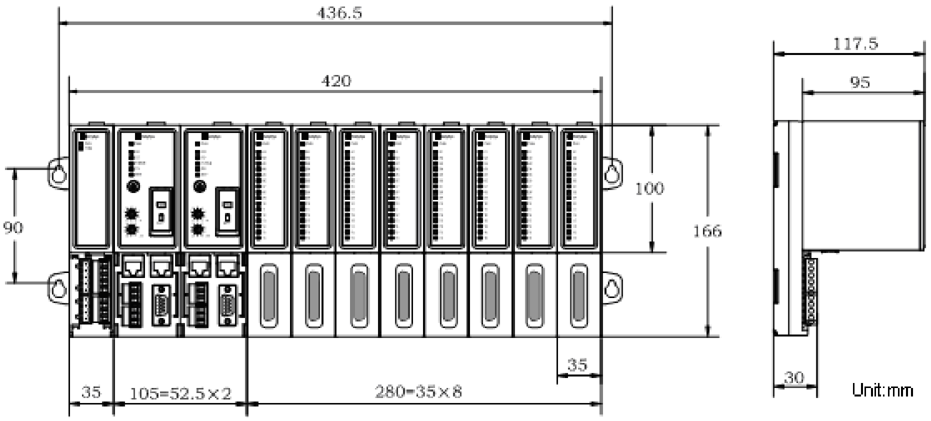


Figure 2.29: LK125 Backplane and its dimension

2.11.4 Technical Specifications

LK125 [11-slot Dual CPU local backplane]	
Slots and interfaces	
Number of slots	11 slots (1 communication slot, 2 controller slot, and 8 I/O slots)
Interrupt input slot	4 slots, next to the 4 I/O slots of the controller
Ethernet interface	RJ45 with LEDs
COM1 serial port	DB9 socket
COM2 serial port	3 pin socket, either RS485 or RS232
ProfiBus-DP interface	4 pin socket, double sockets
Communication extension port	5 pin socket, defined by the communication extension module.
System power supply	5 pin socket, 24V DC system power supply
Isolation Voltage	
Channel to channel	≥1000VAC@1min.， current leakage 5mA
Channel to system	≥1000VAC@1min.， current leakage 5mA
Electrical specifications	
Input Voltage	24VDC (-15% ~ 20%)
Termination resistance	One end fixed, active matching
Physical features	
Installation method	Surface installation
Dimensions	Width x height x depth = 420mm×166mm×55.5mm
Casing protection level	IEC60529 IP20
Weight	1,780g
Working Environment	
Working temperature	0℃~60℃
Working relative humidity	5%~95%, no condensate
Storage temperature	-40℃~70℃
Storage relative humidity	5%~95%, no condensate

Table 2.15: Technical Specification of LK125 Backplane

For details on wiring, cable processing, installation, drilling, layout and grounding, please refer to section 1.7 in chapter 1 on Planning, Layout, and Installation at page 27.

2.12 LK115 [11-SLOT EXPANSION BACKPLANE] PREFABRICATED CABLING TO TERMINAL BLOCK

LK115 is similar to LK111 except for the DB25 interface (different methods of I/O interconnected to terminal blocks via pre-fabricated cabling. Field devices are connected to the terminal blocks instead).

2.12.1 Features

- 1 communication slot and 10 I/O slots
- Redundant ProfiBus-DP interface
- 24VDC working power input
- Frontal interface for prefabricated cabling to terminal block
- Dip switch from station base address
- Module insertion mechanical key preventing incorrect module insertion

LK115 is an 11 slot expansion backplane, where terminal modules are wired in front with prefabricated cables, which are used to connect to onsite signals. As shown in Figure 2.30, the first slot from the left is a communication module slot, which is used to install special LK communication modules. From the second to the eleventh slots are I/O module slots, which are used to install normal I/O modules with DP bus interfaces.

High speed I/O modules cannot be installed on the expansion backplane.

Each DB25 socket corresponds to an I/O module, and is connected to a special terminal module through a prefabricated cable.

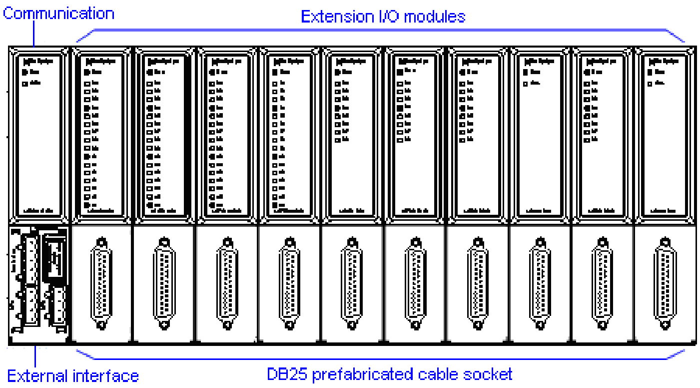


Figure 2.30: The Frontal View of LK115 backplane

2.12.2 Interface

All other interface are similar to LK111, please refer to section 2.9.3 at page 49 for more details.

DB25 prefabricated cable socket

Material code	Model	Specification
3080000062	LKX005	3.0m
3080000063	LKX004	2.0m
3080000064	LKX003	1.2m

Table 2.16: DB25 Prefabricated cables

2.12.3 Dimensions

The widths of all the modules on the expansion backplanes are always 35mm. Hence, for LK115 backplanes, the distance between the centers of the screw holes on both sides will be (35+35x10+16.5) mm = 401.5 mm, as shown in Figure 2.31.

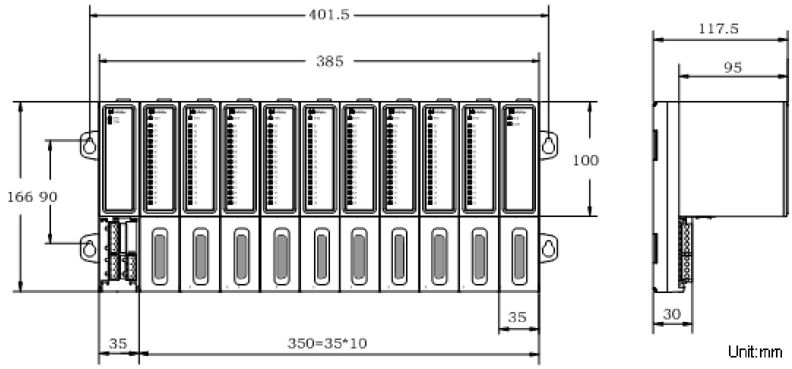


Figure 2.31: LK115 Backplane and its dimension

2.12.4 Technical Specifications

LK115 [11-slot expansion backplane]	
Slots and interfaces	
Number of slots	11 slots (1 communication slot and 10 I/O slots)
Profibus-DP interface	4 pin socket, double sockets
System power supply	5 pin socket, 24V DC system power supply
Isolation Voltage	
Channel to channel	≥1000VAC@1min.， current leakage 5mA
Channel to system	≥1000VAC@1min.， current leakage 5mA
Electrical specifications	
Input Voltage	24VDC±10%
Termination resistance	N/A. May be provided by the communication module.
Physical features	
Installation method	Surface installation
Dimensions	Width x height x depth = 385mm×166mm×30mm
Casing protection level	IEC60529 IP20
Weight	1,630g
Working Environment	
Working temperature	0℃~60℃
Working relative humidity	5%~95%, no condensate
Storage temperature	-40℃~70℃
Storage relative humidity	5%~95%, no condensate

Table 2.17: Technical Specification of LK115 Backplane

For details on wiring, cable processing, installation, drilling, layout and grounding, please refer to section 1.7 in chapter 1 on Planning, Layout, and Installation at page 27.

2.13 LK116 [6-SLOT EXPANSION BACKPLANE] PREFABRICATED CABLING TO TERMINAL BLOCK

LK116 is similar to LK113 except for the DB25 interface (different methods of I/O interconnected to terminal blocks via pre-fabricated cabling. Field devices are connected to the terminal blocks instead).

2.13.1 Features

- 1 communication slot and 5 I/O slots
- Redundant ProfiBus-DP interface
- 24VDC working power input
- Frontal interface for prefabricated cabling to terminal block
- Dip switch from station base address
- Module insertion mechanical key preventing incorrect module insertion

LK116 is a 6 slot expansion backplane, where terminal modules are wired in front with prefabricated cables, which are used to connect to onsite signals. As shown in Figure 2.32, the first slot from the left is a communication module slot, which is used to install special LK communication modules. From the second to the sixth slots are I/O module slots, which are used to install normal I/O modules with DP bus interfaces.

High speed I/O modules cannot be installed on the expansion backplane.

Each DB25 socket corresponds to an I/O module, and is connected to a special terminal module through a prefabricated cable.

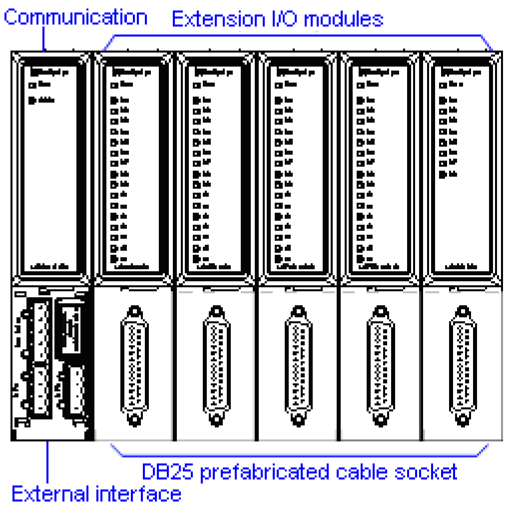


Figure 2.32: The Frontal View of LK116 backplane

2.13.2 Interface Specifications

DB25 prefabricated cable socket

Material code	Model	Specification
3080000062	LKX005	3.0m
3080000063	LKX004	2.0m
3080000064	LKX003	1.2m

Table 2.18: DB25 Prefabricated cables

2.13.3 Dimensions

The widths of all the modules on the expansion backplanes are always 35mm. Hence, for LK115 backplanes, the distance between the centers of the screw holes on both sides will be (35+35x5+16.5) mm = 226.5mm

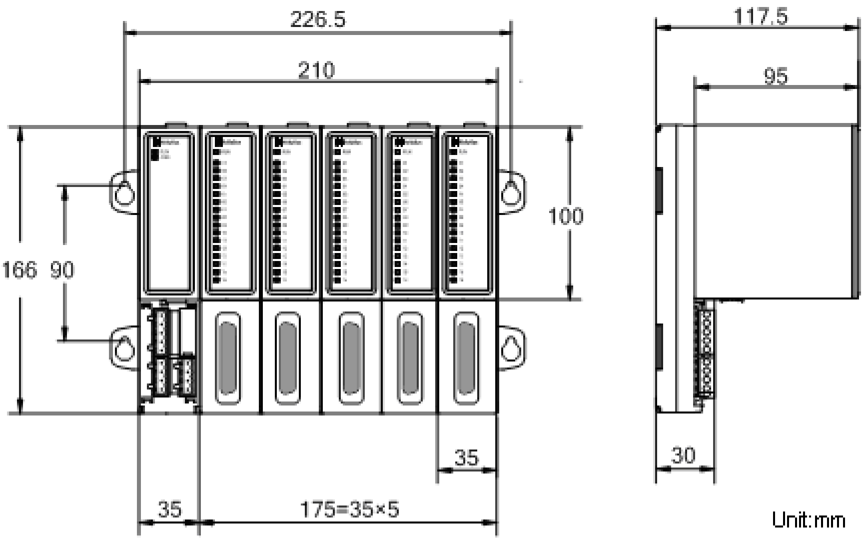


Figure 2.33: LK116 Backplane and its dimension

2.13.4 Technical Specifications

LK116 [6-slot expansion backplane]	
Slots and interfaces	
Number of slots	6 slots (1 communication slot and 5 I/O slots)
Profibus-DP interface	4 pin socket, double sockets
System power supply	5 pin socket, 24V DC system power supply
Isolation Voltage	
Channel to channel	≥1000VAC@1min.， current leakage 5mA
Channel to system	≥1000VAC@1min.， current leakage 5mA
Electrical specifications	
Input Voltage	24VDC±10%
Termination resistance	N/A. May be provided by the communication module.
Physical features	
Installation method	Surface installation
Dimensions	Width x height x depth = 210mm×166mm×30mm
Casing protection level	IEC60529 IP20
Weight	925g
Working Environment	
Working temperature	0℃~60℃
Working relative humidity	5%~95%, no condensate
Storage temperature	-40℃~70℃
Storage relative humidity	5%~95%, no condensate

Table 2.19: Technical Specification of LK116 Backplane

For details on wiring, cable processing, installation, drilling, layout and grounding, please refer to section 1.7 in chapter 1 on Planning, Layout, and Installation at page 27.

Chapter

3

CHAPTER 3: CPU MODULE - LK207/LK210 & LK205/LK209

The LK Series PLC has two variations of CPU module with different speed.

- LK207 & LK205 (533MHz) is designed to support only for single CPU controller
- LK210 & LK209 (266MHz) is designed to support dual CPU controller which runs in redundancy mode.

3.1 COMMON CPU FEATURES

- 16MB Flash Memory, user's program
- 64MB SDRAM user data memory
- 1MB SRAM with power-loss protection
- Redundant ProfiBus-DP master station interface
- Built-in RS232/RS485/Modem port
- Battery slot, SD memory socket
- Supports high-speed local backplane bus
- Supports hot-swap

3.2 DIFFERENCE IN CPU FEATURES

LK207 - Single CPU module	LK205 - Single CPU module	LK210 – Redundancy CPU Module	LK209 – Redundancy CPU Module
533MHz	266MHz	533MHz	266MHz
0.013 µs per step (fix point no.) 0.2 µs per step (floating point no.)	0.03 µs per step (fix point no.) 0.4 µs per step (floating point no.)	0.013 µs per step (fix point no.) 0.2 µs per step (floating point no.)	0.03 µs per step (fix point no.) 0.4 µs per step (floating point no.)
Installed on single CPU local backplane.		Installed on dual CPU redundancy local backplane.	
Does not support controller redundancy.		Support hot-redundancy (master or standby) controller.	
Built-in 10/100 Mbps Ethernet ports		Built-in redundant 10Mbps/100Mbps Ethernet ports	

Table 3.1: Difference in features between LK207/LK210 & LK205/LK209

3.3 CPU FUNCTIONS

- The LK207 & LK205 are single CPU module installed on single CPU local backplane only.
- The LK210 & LK209 are redundancy CPU module installed on the dual CPU redundancy local backplane only.
- Both CPU modules support ProfiBus-DP Master station protocols and high-speed local backplane bus.
- It communicates with normal I/O modules installed either on the local or expansion backplanes via ProfiBus-DP communication bus.
- It communicates with high-speed I/O module installed only on local backplane via high-speed bus.
- The user programs and system program are stored in Flash memory.
  - For the most efficient and fastest operation, the controller module shall first run the system program in the flash memory after power on, and the system program will call the user programs in SDRAM and operate from there onwards.
  - Generally, user programs can be downloaded or updated through Ethernet. If there are special requirement, user programs can also be downloaded or updated through the 512MB SD memory card. However, some system software versions do not support this features.

Please refer to the LK Software Manual for more details on this.

3.4 CPU FRONT PANEL

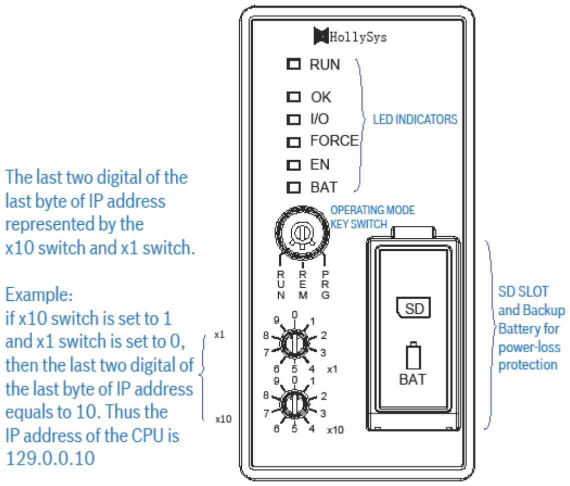


Figure 3.1: The CPU Front Panel

All the CPU front panels are similar in appearance, as shown in Figure 3.1. The front panel of the CPU module comes with:

- 6 LED indicating the real-time CPU controller status.
- 1 selectable key switch to change between different operational modes (RUN, PRG and REM).
- 2 rotational dial switches to set the IP address of the Ethernet communication stations.
- Power-loss protection battery slot and SD memory card socket.

3.4.1 LED Status Indicators and Specifications

LED Indicator	Status	Definition
RUN Yellow & Green	GREEN – Slow flashing	User Program is running, 1Hz flashing frequency
	YELLOW – Slow flashing	User Program stopped, 1Hz flashing frequency
OK Red & Green	RED – Quick flashing	Initialization of the system when power on, 4Hz flashing frequency
	RED – Slow flashing	No User Program found, 1 Hz flashing frequency
	GREEN – ALWAYS ON	Controller working normally
	GREEN - Quick flashing	Downloading of user program in progress
	GREEN - Slow flashing	Controller working normally but the symbol table is not downloaded. (symbol table is used to define the periodic data communication)
I/O Yellow & Green	OFF	I/O module(s) are not configured for the controller
	GREEN – ALWAYS ON	Communication with I/O module(s) are normal
	GREEN - Slow flashing	Abnormal communication with I/O module(s), 1Hz flashing frequency
FORCE Yellow	OFF	No forced data
	YELLOW – ALWAYS ON	Forced data
EN Green	OFF	All outputs are disabled
	GREEN – ALWAYS ON	All outputs are enabled
BAT Red	OFF	Backup battery power is good, normal operation
	RED - ALWAYS ON	Low backup battery power or battery not installed. Power is less than 90% of its rated value.

Table 3.2: LED Status Indicators of the LK207 CPU module

3.4.2 Key Switch for Selecting the Operating Mode

Switch Location	Mode	Function
RUN	Running Mode	User program is running, Outputs are enabled.
REM	Remote Control Mode	Remotely controlled. The operational mode is controlled by remote station. User programs modification are allowed.
PRG	Programming / Stop Mode	User programs is stopped, Outputs are disabled. User programs modification are allowed.

Table 3.3: Key Switch Definition of LK 207 CPU module

A key is used to select between the three selectable operating modes, RUN, REM or PRG. By factory default, the key-switch is set at "REM" mode. The key of this switch may be pulled out under any operating mode condition, RUN, REM or PRG. The working condition of these modes is described as follows:

RUN mode

In running mode, the user's program is running and all the outputs are enabled. The stopping or modification of the program is not allowed using PowerPro® (programming software)

- I/O scanning and calculations tasks are performed by the controller.
- Forced data are not allowed.
- eFieldView® (HMI software) allows writing of variable but the PowerPro® (programming software) does not allow.
- Reset is not allowed.
- Changes of CPU operating mode via remotely through PowerPro® are not allowed.

PRG mode (Programming)

In programming mode, the user's program is stopped and all the outputs are disabled. It cannot be restarted through PowerPro®. Full download and incremental download of user's program are allowed.

- No I/O scanning tasks are performed by the controller.
- Creates, modifies and deletes tasks, programs and processes are allowed.
- Download of user's program is allowed.
- Reset is allowed.
- Changes of CPU operating mode via remotely through PowerPro® are not allowed.

REM mode (Remotely Controlled)

In remotely controlled mode, the operating mode and the stopping of user program are all controlled remotely via PowerPro® (programming software).

- The status of the controller is as follows:
    - **RUN mode to REM mode:**
      When the key switch is turned from RUN mode to REM mode, the user program keeps running.
    - **PRG mode to REM mode:**
      When the key is turned from PRG mode to REM mode, the user program maintains its halt state.
    - **REM mode before Power-On:**
      If the key switch is set at REM before the power-on of CPU module, the user program will halt after the start-up of system program.
- User's program can be downloaded in 'Full download' (after the user program stops) and in 'Incremental download' (during operation or user program stops).
- Forces variables are allowed.
- Write variables are allowed.
- Reset is allowed.
- Changes of CPU operating mode via remotely through PowerPro® are allowed.

Reset

- CPU module hardware can be reset via the key switch.
    - **Reset**: Turn the Key Switch in the order of "REM→RUN→REM→RUN→REM" within 1.5 seconds and the CPU module hardware is reset. All data will be reset to their initial values except those retained in power-loss protection memory (example: the retain variables). The user program will halt after reset.
- User's program can be reset through the programming software by the following methods:
    - Reset:
        - All data are reset to their initial value.
        - The 'retainable value' which resides in the power-loss protection memory is not reset.
        - The user's program will halt after reset.
    - Reset (cold):
        - All data are reset to their initial value.
        - All 'retainable value' which resides in the power-loss protection memory is cleared.
        - The user's program will halt after reset.
    - **Reset (original)** - Clear User Programs:
        - All user program and data are reset to to their initial values.

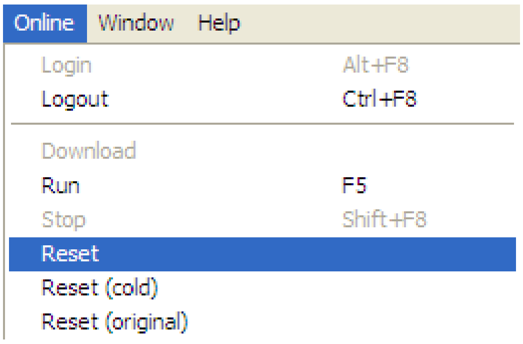


Figure 3.2: Reset Options of Programming Software

3.4.3 Retaining Data during Power-loss

- User's programs saved in FLASH memory are retained during power loss automatically.
- The LK CPU controller module can retain data at its 1MB power-loss protection memory (SRAM) which is powered by its backup battery at a period of not more than 6 months.
- The real-time values of retain variables in user programs are retained. When the CPU restarts, the retain variables will resume its retained values before power loss while other variables adopt their initial values.

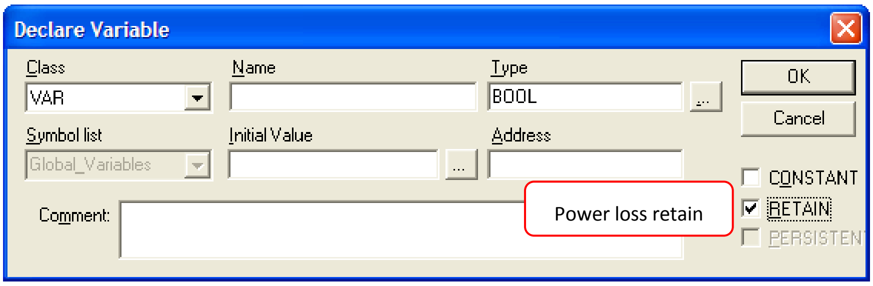


Figure 3.3: Power-Loss Protection Configuration of LK CPU Module

- The backup battery is installed on the front panel of the LK CPU module. The LED indicator will be turned ON red in color when the battery power is low. The battery should be checked regularly and should be changed upon low power to ensure that the power-loss protection feature continues to works properly.

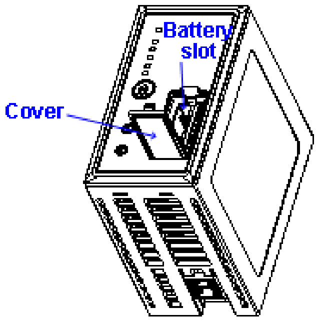


Figure 3.4: Backup Battery Slot of LK207 CPU Module

3.5 ETHERNET IP ADDRESSING FOR SINGLE CPU CONTROLLER

3.5.1 IP Addressing for LK207 / LK205

For LK Ethernet networking system, only static logically IP address is used for TCP/IP communications. Each IP address consists of 4 bytes to represent the typical IP address format such as 129.0.0.10.

3.5.2 LK207/LK205 Network Connections

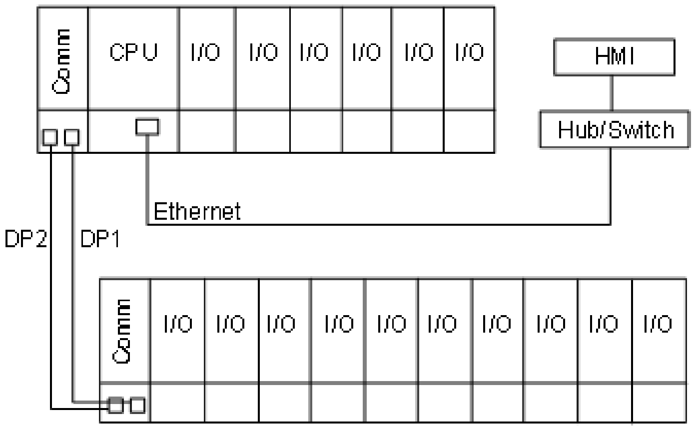


Figure 3.5: Network Connection for LK207Single CPU Controller

In LK system, the build-in Ethernet port of LK207/LK205 is configured to use sub-net 129. The first three bytes of the IP address is 129.0.0. This configuration can be modified via the PowerPro programming software. The last byte of the IP address is configured by the two rotational dial switches found on the front panel of the CPU module. The last sub-net of the IP address is within the scope of 10 to 99 (0~9 are reserved addresses for special function). By factory default, the CPU module is configured as 129.0.0.10.

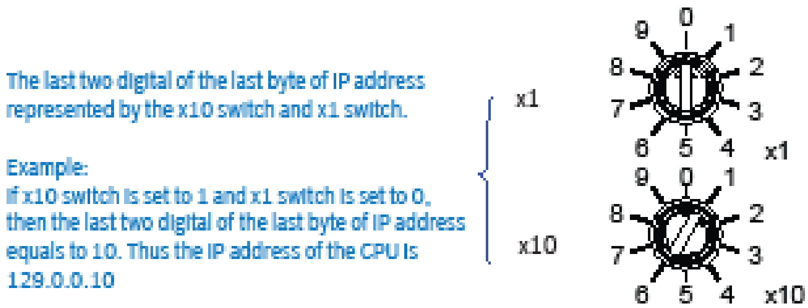


Figure 3.6: IP Address Configuration of CPU Module

The IP address of the CPU module is also referred as the Station Number of the controller.

Station No.	Default IP Address
Station No. 10	129.0.0.10
Station No. 11	129.0.0.11
……	……
Station No. N	129.0.0.n

Table 3.4: Default IP Address Allocation of LK207 CPU module

3.5.3 PowerPro Configuration for LK207/LK205

Using PowerPro programming software, the ‘Communication Parameters’ needs to be setup with the IP addresses of the CPU module in order to establish a connection between the computer and the PLC.

- For example, taking Station No.10 with default segment 129, the steps to configure communication parameters are as follows:
  - Select “Communication Parameters” from the “Online” menu. The “Communication Parameter” windows will pop up.

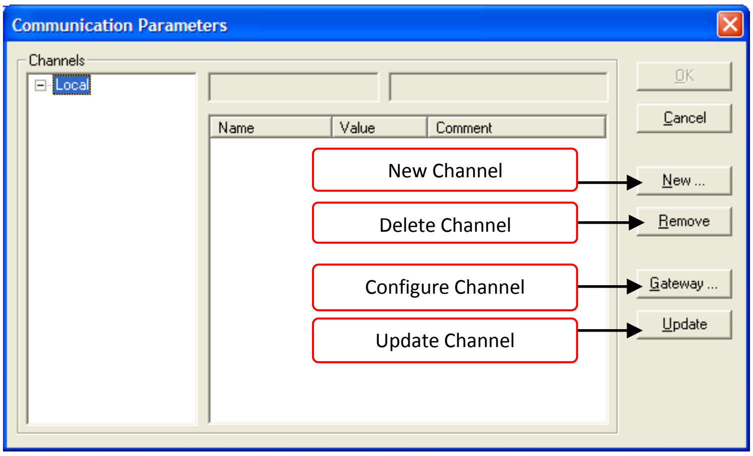


Figure 3.7: Configuration of PLC Communication Parameters (1)

- Select "New" button to create new channel for communication.

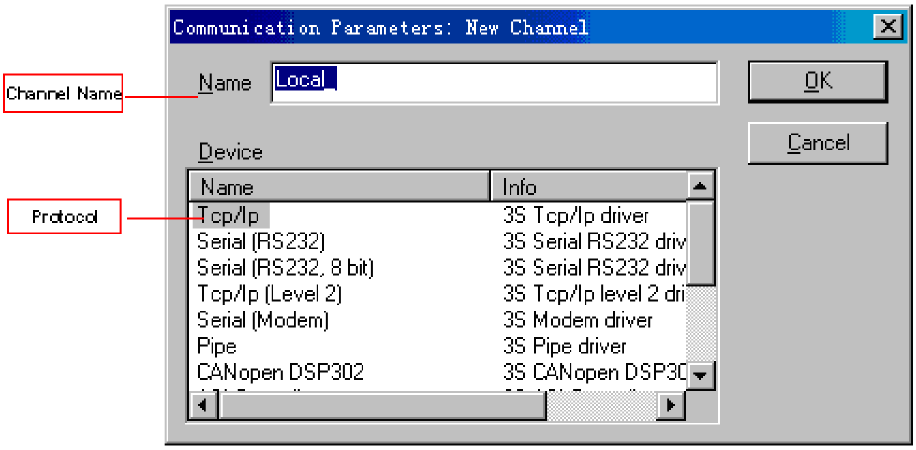


Figure 3.8: Configuration of PLC Communication Parameters (2)

- The default channel name is "Local_". Rename it to '**129.10**' and the communication protocol is the default using '**Tcp/Ip**' protocol. Click button "OK" and return to "Communication Parameters" window.

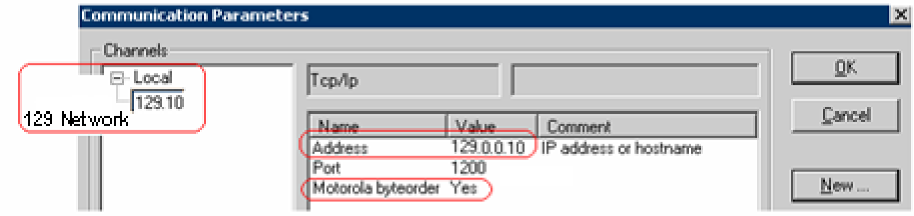


Figure 3.9: Configuration of PLC Communication Parameters (3)

- Double click the "Value" field of "Address" and set it as "129.0.0.10".
- The "Value" field of "Motorola byteorder" must be set as "Yes", otherwise the communication cannot be established. This parameter indicates that the CPU chip of LK207 adopts the Motorola byte order, which stores the high byte of a word variable in the low memory address and the low byte in the high memory address.
- "Port" indicates the TCP communication port number, which is pre-fixed as 1200 and cannot be changed to other values. Otherwise the communication cannot be established.
- If the first three bytes of the IP address (129.0.0) is modified via the programming software, communication will stop in between computer and PLC. New configuration parameters shall be configured to re-establish the new network communication.

3.6 ETHERNET IP ADDRESSING FOR DUAL CPU CONTROLLER

3.6.1 Controller Redundancy for LK210/LK209

LK210/LK209 CPU module supports hot redundancy of the master and standby controllers. It also ensures that at any one time, only the controller's instructions from the master controller are transmitted to the I/O equipments.

After power on, the redundant CPU modules installed on the backplane will be automatically configured to run as master and standby controllers. The master and standby controllers operate simultaneously while the master controller controls the outputs and standby controller acts as backup. When failure occurs to the master controller, the standby controller will automatically switch over and act as master controller to ensure a continuous running of the system process.

The two redundant controllers are named as Controller A and Controller B. As shown in Figure 3.10, the CPU module installed in the first CPU slot from the left is Controller A and the second CPU slot next installed in the second is Controller A. After power on, the system automatically assigns the master controller and standby controller that can be distinguished by the indicators on the front panel (the RUN light of master controller is constantly on while that of standby controller is flashing quickly. Normally, Controller A is the master controller while Controller B is standby.

The master and standby controllers will shift in the following situations:

- When the master controller has self-diagnosed failure and the standby controller works normally, the master and standby will be shifted.
- When master controller is resetting, the master and standby will be shifted.

3.6.2 LK210/LK209 Network Connections

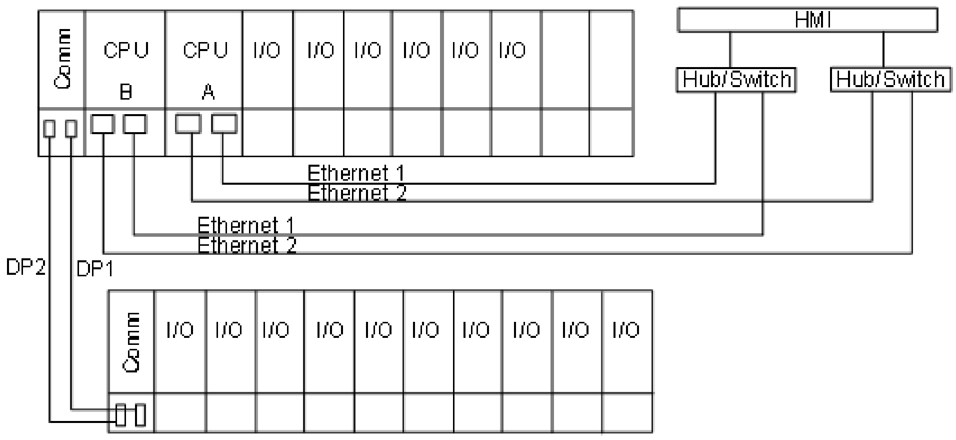


Figure 3.10: Network Connection for LK210 CPU Module with Controller Redundancy

In LK CPU redundancy system, the build-in Ethernet port of each CPU is configured to use sub-net 128 and 129. By default, the first three bytes of the IP address is 128.0.0 or 129.0.0. This configuration can be modified via the PowerPro programming software. The last byte of the IP address for Controller A is configured by the two rotational dial switches found on the front panel of the CPU module. The last sub-net of the IP address is within the scope of 10 to 99 (0~9 are reserved addresses for special function). While the last IP address byte of Controller B equals to "the address set by dial switches + 128". The Dial switches of Controller A and B shall be set as the same.

- For example, when the two redundant CPU modules have their Dial switches for the tens place set to "1" and those for the ones place set to "0", then the last bye of IP address for Controller A is 10 and that of Controller B is "10+128=138". Therefore,
  - For controller A, the 128 network segment IP address of Controller A is 128.0.0.10 and 129 network segment IP address is 129.0.0.10.
  - For controller B, the 128 network segment IP address of Controller B is 128.0.0.138 while the 129 network segment IP address is 129.0.0.138.

With reference to Figure 3.10, each CPU module has two redundant Ethernet ports. i.e. a total of 4 Ethernet ports.

- The 129 network segment named as ETHERNET1
- The 128 network segment named as ETHERNET2.

For best network reliability with redundancy, each network segment shall use different network switches.

Default Station No.		Station No. 10	Station No. 11	Station No. N
Controller A	128 network segment	128.0.0.10	128.0.0.11	128.0.0.n
	129 network segment	129.0.0.10	129.0.0.11	129.0.0.n
Controller B	128 network segment	128.0.0.138	128.0.0.139	128.0.0.(n+128)
	129 network segment	129.0.0.138	129.0.0.139	129.0.0.(n+128)

Table 3.5: Default IP Address Allocation of LK210 CPU module

The last byte of the IP address of the master controller CPU module is also referred as the Station Number of the controller.

For example, Controller A of No.11 controller station has redundant Ethernet IP addresses of 128.0.0.11 and 129.0.0.11 while Controller B of this station has redundant Ethernet IP addresses of 128.0.0.139 and 129.0.0.139.

Note: when two LK 210 modules are configured as redundant, the station number of Controller A and Controller B shall be the same.

3.6.3 PowerPro Configuration for LK210/LK209

Using PowerPro programming software, the 'Communication Parameters' needs to be setup with the IP addresses of the CPU module in order to establish a connection between the computer and the PLC. Necessary communication parameters need to be setup for the two network segments of each controller to correctly establish the network communication.

For example, taking Station No.10 with default segment of 128 and 129, the steps to configure communication parameters are as follows:

- Choose "Communication Parameters" from the "Online" menu. The "Communication Parameter" windows will pop up.

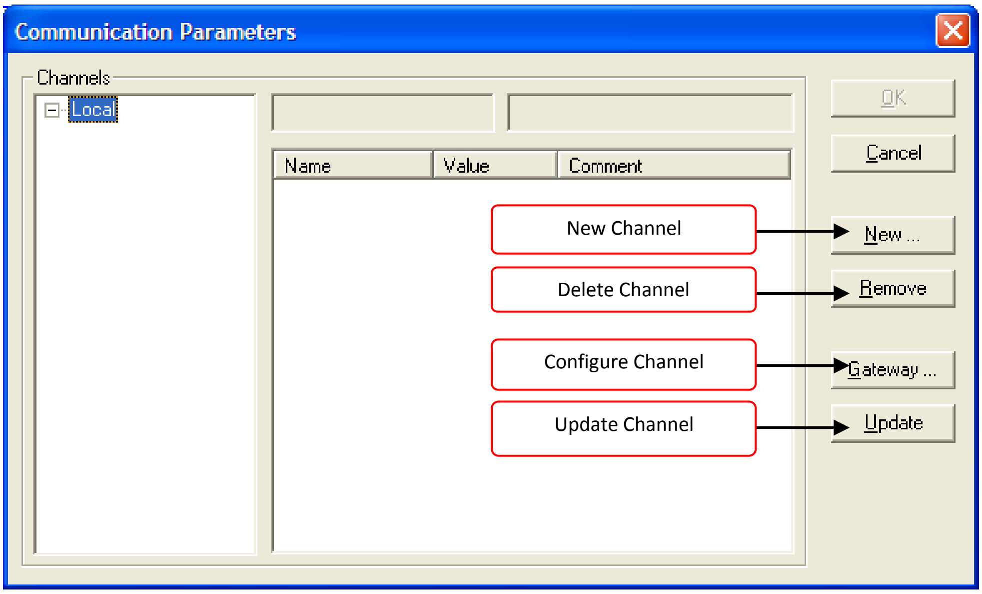


Figure 3.11: Configuration of PLC Communication Parameters (1)

- Select the "New" button to create new channel for communication.

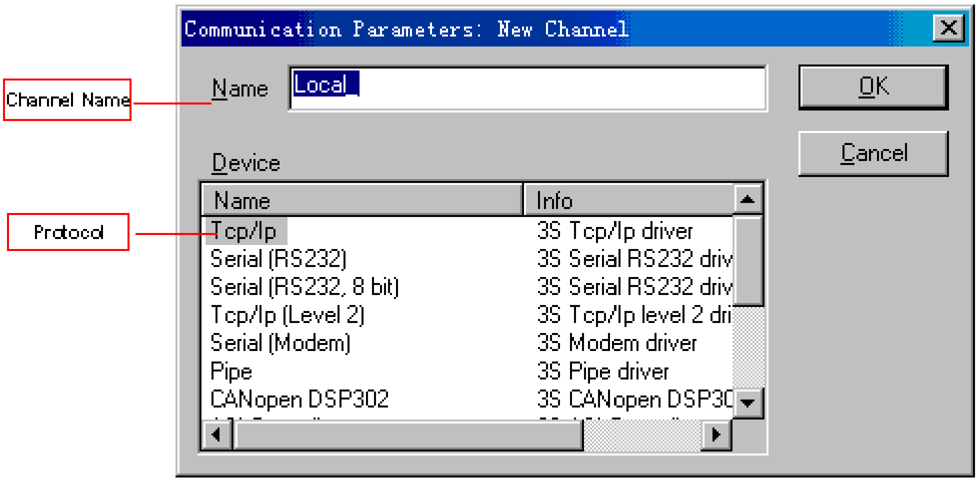


Figure 3.12: Configuration of PLC Communication Parameters (2)

- The default channel name is "Local_". Rename it to '**128.10**' and the communication protocol is the default using '**Tcp/Ip**' protocol. Click button "OK" and return to "Communication Parameters" window.

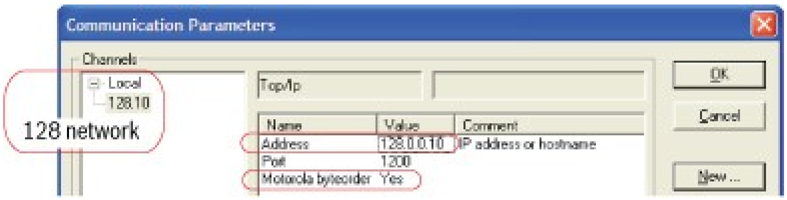


Figure 3.13: Configuration of PLC Communication Parameters (3)

- Double click the "Value" field of "Address" and set it as "128.0.0.10".
- The "Value" field of "Motorola byteorder" must be set as "Yes", otherwise the communication cannot be established. This parameter indicates that the CPU chip of LK210/LK209 adopts the Motorola byte order, which stores the high byte of a word variable in the low memory address and the low byte in the high memory address.
- "Port" indicates the TCP communication port number, which is pre-fixed as 1200 and cannot be changed to other values; otherwise the communication cannot be established.
- Repeat step 2~5 to add 128 and 129 network segments for all the controllers and set their parameters respectively.
- If the first three bytes of the IP address is modified via the programming software, communication will stop in between computer and PLC. New configuration parameters shall be configured to re-establish the new network communication.

3.7 CPU INSTALLATION

The LK CPU module(s) are installed on the CPU socket of the local backplane as shown on in Figure 3.14. Upon a complete debugging and testing, the CPU module can also be secured tightly by using one M3x20 screw at the top of the CPU module. To avoid damages to the module, please do not fasten the screw too tightly. (Torque less than 3 ~ 4 Kgf-cm).

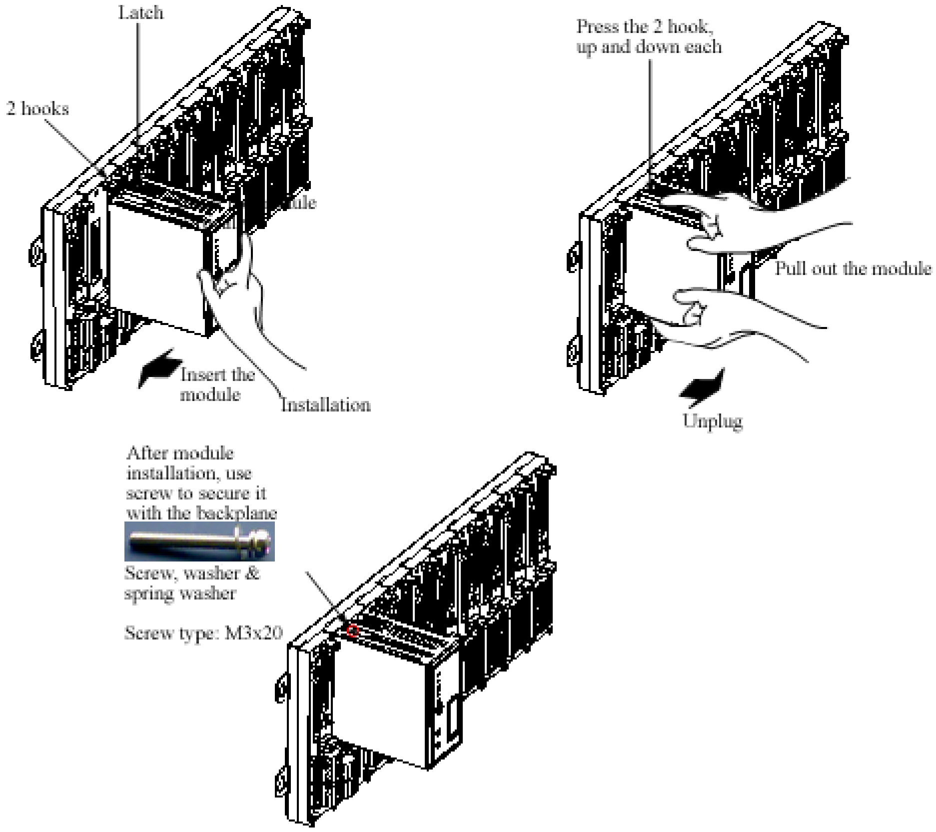


Figure 3.14: Installation and Removal of the LK CPU Modules

3.8 TECHNICAL SPECIFICATION OF LK207

LK207 CPU Module for Single CPU Backplane	
Computation Speed	
CPU Frequency	533MHz
Computation speed of fix point numbers	0.013 µs per step
Computation speed of floating point numbers	0.2 µs per step
Memory	
FLASH	16M bytes
SDRAM	64M bytes
SRAM	1M bytes (power-loss protection)
EEPROM	256 bytes
SD card	512M
Real-time Clock	
Data Format	Year/Month/Date/Hour/Minute/Second, BDC code
High Speed Bus	
Communication Rate	2.6 µs per byte (CPU to Local I/O)
Max. no. of high-speed I/O modules on local backplane	8x I/O modules at max.
Ethernet	
10/100Mbps	1x channel, IEEE802.3/u, output through RJ45 port on the backplane
ProfiBus-DP	
Physical Interface	2x channels redundant communication, 4pin connector socket, ProfiBus-DP Type-A (shielded twist-pair cable) or Type-B (non-shielded twist-pair cable)
Protocol	IEC61158-3 Type3, En50170
Communication Bandwidth	1.5Mbps, 500Kbps, 187.5Kbps, 93.75Kbps, 45.45Kbps, 31.25Kbps, 19.2Kbps, 9.6Kbps
Expansion Serial Ports	
COM2: RS232 or RS485	1x channel, 2x 3pin terminal sockets, can be configured as RS232 or RS485
COM1: MODEM interface	1x channel, DB9 (female-type)
System Power Supply	
Input Voltage	24VDC（-15%~+20%）
Power Consumption	250mA@24VDC max.
Hot swap	Support
Backup Battery	3.0V Rated 120mAh
Retain time after Power-loss	6 months
Battery Low Voltage Alarm	Support, set alarm when voltage lower then 3.0V×90%
Program Execution	
Internal event triggered tasks	Support at most 32 tasks
Continuous operated tasks	
Programming Language	IEC61131-3 Standard: Function Block Diagram (FBD), Instruction List (IL), Ladder Diagram (LD), Structure Text (ST), Sequence Function Chart, and also Continuous Function Chart (CFC).
Physical Features	
Supporting Backplane	Local single CPU local backplane
Module Dimension	Width × Height × Depth = 52.5mm×100mm×100mm
Environment IP Protection Level	IEC60529, IP20
Weight	280g
Working Environment	
Working Temperature	0~60°C
Working Relative Humidity	5%~95%, non-condensing
Storage Temperature	-40~85°C
Storage Temperature	5%~95%, non-condensing

Table 3.6: Technical Specification of LK207 CPU Module

3.9 TECHNICAL SPECIFICATION OF LK210

LK210 CPU Module for Redundant CPU Backplane	
Computation Speed	
CPU Frequency	533MHz
Computation speed of fix point numbers	0.013 µs/step
Computation speed of floating point numbers	0.2 µs/step
Memory	
FLASH	16M bytes
SDRAM	64M bytes
SRAM	1M bytes (power-loss protection)
EEPROM	256 bytes
Real-time Clock	
Data Format	Year/Month/Date/Hour /Minute/Second, BDC code
High Speed Bus	
Communication Rate	2.6 µs per byte (CPU to Local I/O)
Max. no. of high-speed I/O modules on local backplane	8x I/O modules at max.
Ethernet	
10/100Mbps	2x channel, IEEE802.3/u, output through RJ45 port on the backplane
ProfiBus-DP	
Physical Interface	2x channels redundant communication, 4pin connector socket, ProfiBus-DP Type-A (shielded twist-pair cable) or Type-B (non-shielded twist-pair cable)
protocol	IEC61158-3 Type3, En50170
Communication Bandwidth	1.5Mbps, 500Kbps, 187.5Kbps, 93.75Kbps, 45.45Kbps, 31.25Kbps, 19.2Kbps, 9.6Kbps
Expansion Serial Ports	
COM2: RS232 or RS485	1x channel, 2x 3pin terminal sockets, can be configured as RS232 or RS485
COM1: MODEM interface	1x channel, DB9 (female-type)
Dual CPU Redundancy	
Data Synchronization Speed	The two redundant LK210 modules synchronize their data through the backplane with a speed of 1.2µs per byte.
System Power Supply	
Input Voltage	24VDC（-15%~+20%）
Power Consumption	250mA@24VDC max.
Hot swap	Support
Backup Battery	3.0V Rated 120mAh
Retain time after Power-loss	6 months
Battery Low Voltage Alarm	Support, set alarm when voltage lower then 3.0V×90%
Program Execution	
Continuous operated tasks	Support at most 32 tasks
Internal event triggered tasks	
Programming Language	IEC61131-3 Standard: Function Block Diagram (FBD), Instruction List (IL), Ladder Diagram (LD), Structure Text (ST), Sequence Function Chart, and also Continuous Function Chart (CFC).
Physical Features	
Installation	Installation on backplane sockets
Supporting Backplane	Local redundant CPU backplane
Module Dimension	Width × Height × Depth = 52.5mm×100mm×100mm
Environment IP Protection Level	IEC60529, IP20
Weight	280g
Working Environment	
Working temperature	0~60°C
Working Relative Humidity	5%~95%, no condensate
Storage Temperature	-40~85°C
Storage Temperature	5%~95%, no condensate

Table 3.7: Technical Specification of LK210 CPU Module

3.10 TECHNICAL SPECIFICATION OF LK205

LK205 CPU Module for Single CPU Backplane	
Computation Speed	
CPU Frequency	266MHz
Computation speed of fix point numbers	0.03 µs per step
Computation speed of floating point numbers	0.4 µs per step
Memory	
FLASH	16M bytes
SDRAM	64M bytes
SRAM	1M bytes (power-loss protection)
EEPROM	256 bytes
SD card	512M
Real-time Clock	
Data Format	Year/Month/Date/Hour/Minute/Second, BDC code
High Speed Bus	
Communication Rate	2.6 µs per byte (CPU to Local I/O)
Max. no. of high-speed I/O modules on local backplane	8x I/O modules at max.
Ethernet	
10/100Mbps	1x channel, IEEE802.3/u, output through RJ45 port on the backplane
ProfiBus-DP	
Physical Interface	2x channels redundant communication, 4pin connector socket, ProfiBus-DP Type-A (shielded twist-pair cable) or Type-B (non-shielded twist-pair cable)
Protocol	IEC61158-3 Type3, En50170
Communication Bandwidth	1.5Mbps, 500Kbps, 187.5Kbps, 93.75Kbps, 45.45Kbps, 31.25Kbps, 19.2Kbps, 9.6Kbps
Expansion Serial Ports	
COM2: RS232 or RS485	1x channel, 2x 3pin terminal sockets, can be configured as RS232 or RS485
COM1: MODEM interface	1x channel, DB9 (female-type)
System Power Supply	
Input Voltage	24VDC（-15%~+20%）
Power Consumption	250mA@24VDC max.
Hot swap	Support
Backup Battery	3.0V Rated 120mAh
Retain time after Power-loss	6 months
Battery Low Voltage Alarm	Support, set alarm when voltage lower then 3.0V×90%
Program Execution	
Internal event triggered tasks	Support at most 32 tasks
Continuous operated tasks	
Programming Language	IEC61131-3 Standard: Function Block Diagram (FBD), Instruction List (IL), Ladder Diagram (LD), Structure Text (ST), Sequence Function Chart, and also Continuous Function Chart (CFC).
Physical Features	
Supporting Backplane	Local single CPU local backplane
Module Dimension	Width × Height × Depth = 52.5mm×100mm×100mm
Environment IP Protection Level	IEC60529, IP20
Weight	280g
Working Environment	
Working Temperature	0~60°C
Working Relative Humidity	5%~95%, non-condensing
Storage Temperature	-40~85°C
Storage Temperature	5%~95%, non-condensing

Table 3.8 : Technical Specification of LK205 CPU Module

3.11 TECHNICAL SPECIFICATION OF LK209

LK209 CPU Module for Redundant CPU Backplane	
Computation Speed	
CPU Frequency	266MHz
Computation speed of fix point numbers	0.03 µs/step
Computation speed of floating point numbers	0.4 µs/step
Memory	
FLASH	16M bytes
SDRAM	64M bytes
SRAM	1M bytes (power-loss protection)
EEPROM	256 bytes
Real-time Clock	
Data Format	Year/Month/Date/Hour /Minute/Second, BDC code
High Speed Bus	
Communication Rate	CPU to Local I/O: 2.6 µs per byte
Max. no. of high-speed I/O modules on local backplane	8x I/O modules at most
Ethernet	
10/100Mbps	2x channels, IEEE802.3/u, output through RJ45 port on the backplane
ProfiBus-DP	
Physical Interface	2x channels redundant communication, 4pin connector socket, ProfiBus-DP Type-A (shielded twist-pair cable) or Type-B (non-shielded twist-pair cable)
protocol	IEC61158-3 Type3, En50170
Communication Bandwidth	1.5Mbps, 500Kbps, 187.5Kbps, 93.75Kbps, 45.45Kbps, 31.25Kbps, 19.2Kbps, 9.6Kbps
Expansion Serial Ports	
COM2: RS232 or RS485	1x channel, 2x 3pin terminal sockets, can be configured as RS232 or RS485
COM1: MODEM interface	1x channel, DB9 (female-type)
Dual CPU Redundancy	
Data Synchronization Speed	The two redundant LK209 modules synchronize their data through the backplane with a speed of 1.2µs per byte.
System Power Supply	
Input Voltage	24VDC（-15%~+20%）
Power Consumption	250mA@24VDC max.
Hot swap	Support
Backup Battery	3.0V Rated 120mAh
Retain time after Power-loss	6 months
Battery Low Voltage Alarm	Support, set alarm when voltage lower then 3.0V×90%
Program Execution	
Continuous operated tasks	Support at most 32 tasks
Internal event triggered tasks	
Programming Language	IEC61131-3 Standard: Function Block Diagram (FBD), Instruction List (IL), Ladder Diagram (LD), Structure Text (ST), Sequence Function Chart, and also Continuous Function Chart (CFC).
Physical Features	
Installation	Installation on backplane sockets
Supporting Backplane	Local redundant CPU backplane
Module Dimension	Width × Height × Depth = 52.5mm×100mm×100mm
Environment IP Protection Level	IEC60529, IP20
Weight	280g
Working Environment	
Working temperature	0~60°C
Working Relative Humidity	5%~95%, no condensate
Storage Temperature	-40~85°C
Storage Temperature	5%~95%, no condensate

Table 3.9 : : Technical Specification of LK209 CPU Module

Chapter

4

CHAPTER 4: COMMUNICATION MODULES

4.1 LK231 [PROFIBUS-DP COMMUNICATION MODULE]

LK231 is a communication module for ProfiBus-DP, and its main function is to:

- Convert the system 24VDC to 5VDC so as to provide power required by ProfiBus-DP
- Active matching termination of the local high speed bus. There is a jumper in the module where it can be set whether to configure active matching resistor networks for DP bus.
- Interconnect the DP signal from the current backplane to the next expansion backplane.

LK231 modules do not need to be configured by software.

LK231 modules are installed in the left most slot on backplanes and the mechanic key is A5.

4.1.1 Features of LK231

- Provide termination resistance for ProfiBus-DP bus.
- Installed on the first slot from the left on local backplanes and expansion backplanes
- Interconnect a ProfiBus-DP to the next backplane.
- Support hot swap

4.1.2 Operation Principles of LK231

The DP bus of a local backplane is connected to the LK231 of an expansion backplane via terminal connectors. The DP bus will then be connected to the DP bus on the expansion backplane via the LK231 module, which establishes the communication between the controller and extension I/O modules.

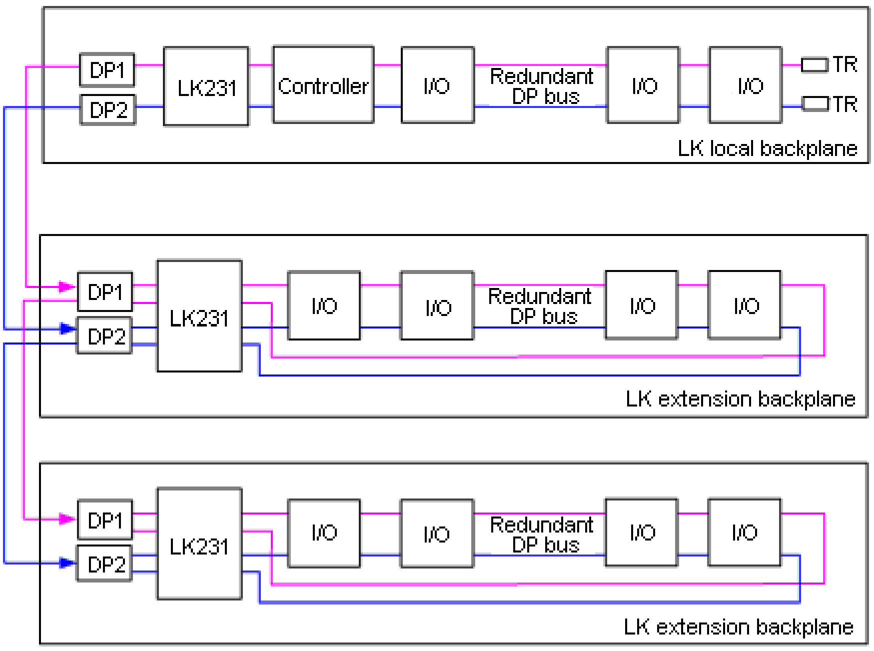


Figure 4.1: DP bus connection to expansion backplane

4.1.3 Termination Resistor of LK231

To reduce signal reflection, a terminal resistor has to be placed between the ends of the differential signal of RS485 at both ends of the DP bus to match the resistance, and termination resistors cannot be connected to

intermediate nodes. As shown in Figure 4.2 and Figure 4.3, the matching resistor at the near end is provided by the local backplane, whereas the matching resistor of the far end is provided by the LK231 module.

Through the jumper settings in the LK231 module, it can be chosen whether to provide active termination resistor network for DP bus. The default setting of the jumper is that there is no matching termination resistor. Only the DP bus on the furthest backplane needs to have a matching termination resistor, which can be configured by the user according to the circumstances. When pins 1 and 2 of the jumper are closed, the matching terminator is connected; when pins 2 and 3 of the jumper are closed, the terminator will not be used.

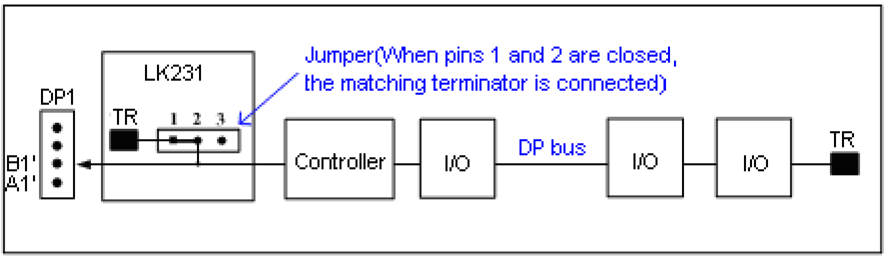


Figure 4.2: Jumper setting of LK231 on local backplane

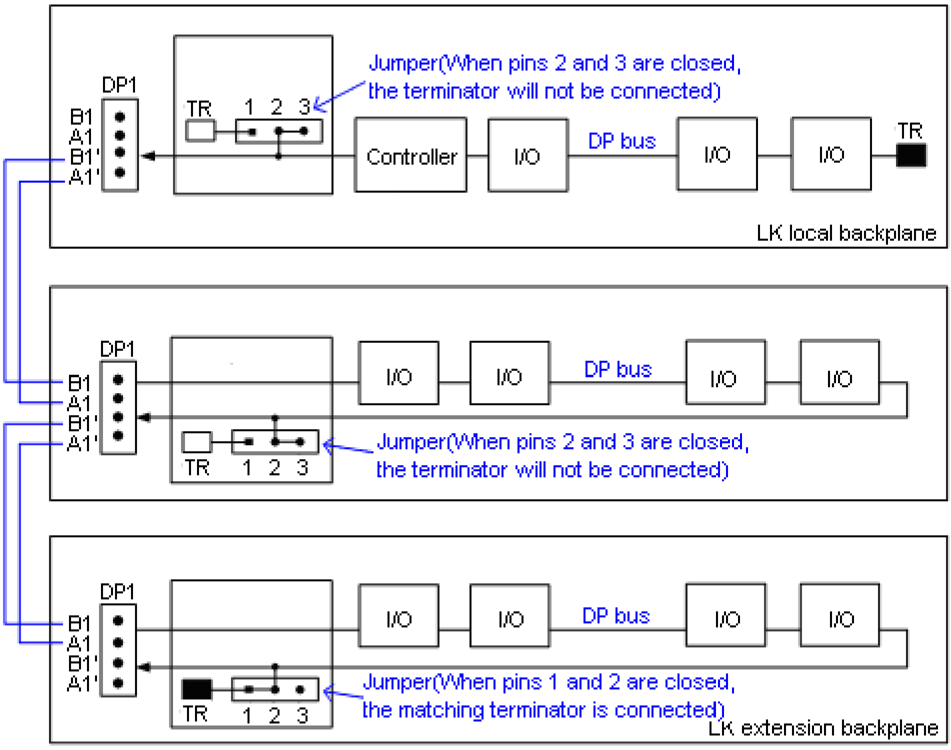


Figure 4.3: Jumper setting of LK231 on cascaded backplanes

The jumper is located on the internal printed circuit board inside LK231 module, and the default setting is that matching termination resistor is not connected. To change the jumper setting, it is required to remove the upper cover of the LK231 module and take out the printed circuit board.

Note: During the process of taking out the circuit board, setting jumpers and putting the circuit board back, it is strictly prohibited to touch IC chips and the surface of the circuit board with bare hands to prevent circuit damages caused by static charge. Whenever possible, it is recommended that anti-static glove to be used or other anti-static measures to be taken. Otherwise, cautions should be taken and only use hands to hold the edges of the printed circuit boards.

There is a pair of hooks on both the upper and lower sides of the top cover of the module, which are hooked into slots corresponding to the case of the module. When removing the module, first lift the hooks from the slots using a screw driver, remove the top cover, and pull out the printed circuit board.

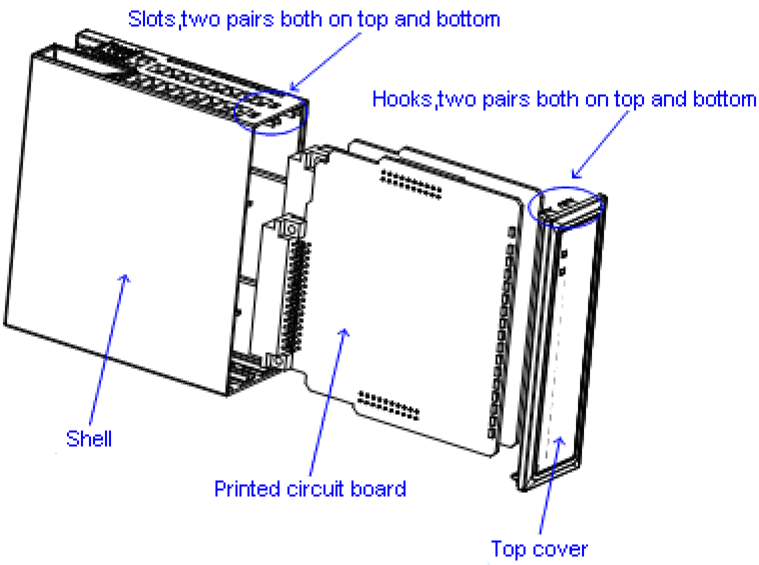


Figure 4.4: Internal Circuit board of LK231

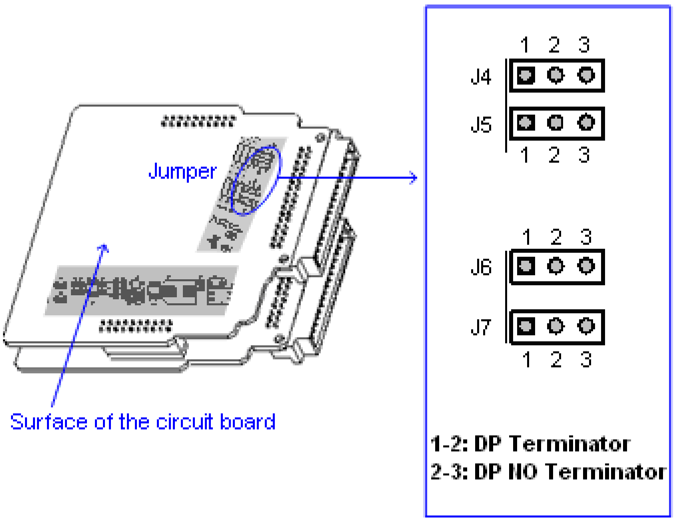


Figure 4.5: DP Terminator jumper setting of LK231

- There are four groups of jumpers, namely J4, J5, J6 and J7, which have to be set consistently.
  - When pins 1 and 2 are closed, the termination resistor is connected.
  - When pins 2 and 3 are closed, the termination resistor is disconnected (default).

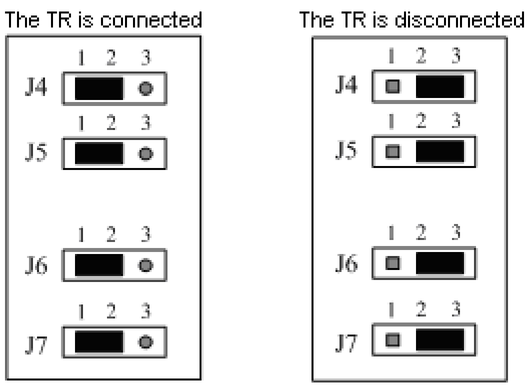


Figure 4.6: TR jumper settings (Connected / Disconnected)

4.1.4 Indicator Definition of LK231

The indicators of LK231 are defined as in Table 4.1. When normal data packet transmission made by the controller is detected, the RUN indicator is lit up, and the COM indicator is lit up.

RUN indicator (green)	COM indicator (yellow)	Definition
Off	Off	Power Off or Module Failure
Flashing (On for 125ms and off for 125ms.)	Off	Just power on and communication has not been established, or error in communication.
On	On	Communication has been established and DP network is working normally.

Table 4.1: Indicator definition of LK231

4.1.5 Module Installation and Un-installation

Refer to chapter 1 on "Module Insertion Mechanical keys" and "Module Insertion and Removable" for more details.

4.1.6 Technical Specification of LK231

LK231 ProfiBus-DP communication module	
System power supply	
Voltage	24VDC (-15% ~ +20%)
Power Consumption (max)	50mA max@24VDC
Signal Channel	
Data Format	Only used to interconnect ProfiBus-DP on the physical layer, and will not send any data on the DP bus.
Communication Bus	
Protocol	ProfiBus-DP slave station. Compliant with IEC61158-3/EN50170 standard
Communication Rate	9.6Kbps, 19.2Kbps, 31.25Kbps, 45.45Kbps, 93.75Kbps, 187.5Kbps, 500Kbps and 1.5Mbps adaptive
Communication media hot backup redundancy	Supported
Physical features	
Installation method	Slot installation
Installation location	Communication slots on LK local backplanes and expansion backplanes
Mechanic keys that prevent incorrect insertion	A5
Hot Swap	Supported
Dimensions	Width x height x depth = 35mm×100mm×100mm
Casing protection level	IEC60529 IP20
Weight	170g
Working Environment	
Working Temperature	0℃~60℃
Working Relative Humidity	5%~95%, no condensate
Storage Temperature	-40℃~70℃
Storage relative humidity	5%~95%, no condensate

Table 4.2: Technical specification of LK231

4.2 LK232 [PROFIBUS-DP BUS REPEATER]

LK232 modules are installed on the left-most slots of local backplanes or expansion backplanes to provide bus repeating functions.

4.2.1 Features of LK232

- Extend the physical lengths of ProfiBus-DP buses
- Isolate two segments of ProfiBus-DP
- Provide termination resistance for ProfiBus-DP bus
- Change the topology of ProfiBus-DP
- Installed on local backplanes or expansion backplanes
- Support hot swap

4.2.2 Operating Principles of LK232

- When the transmission distance is too long, or the load is too high, the quality of the signals being transmitted on the twisted cables will degrade. An LK232 module selects one of the two redundant DP signal channels that works normally and outputs two channels of DP signals after regulations and amplification, as shown in Figure 4.7.

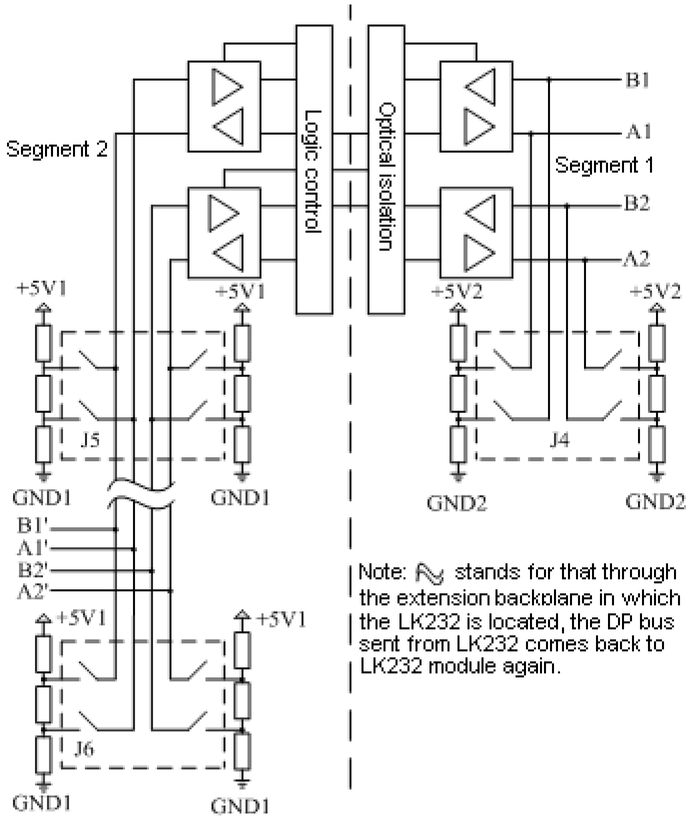


Figure 4.7: Bus Interconnection when LK232 is installed on the expansion backplane

- Sometimes a bus topology does not meet the needs of the users very well when sites are separated. An LK232 module can select one of the two redundant DP signals that work normally and output one channel of DP signal after regulation and amplification, so the DP signal is divided into two branches to achieve star connections, which changes the bus topology, as shown in Figure 4.8.

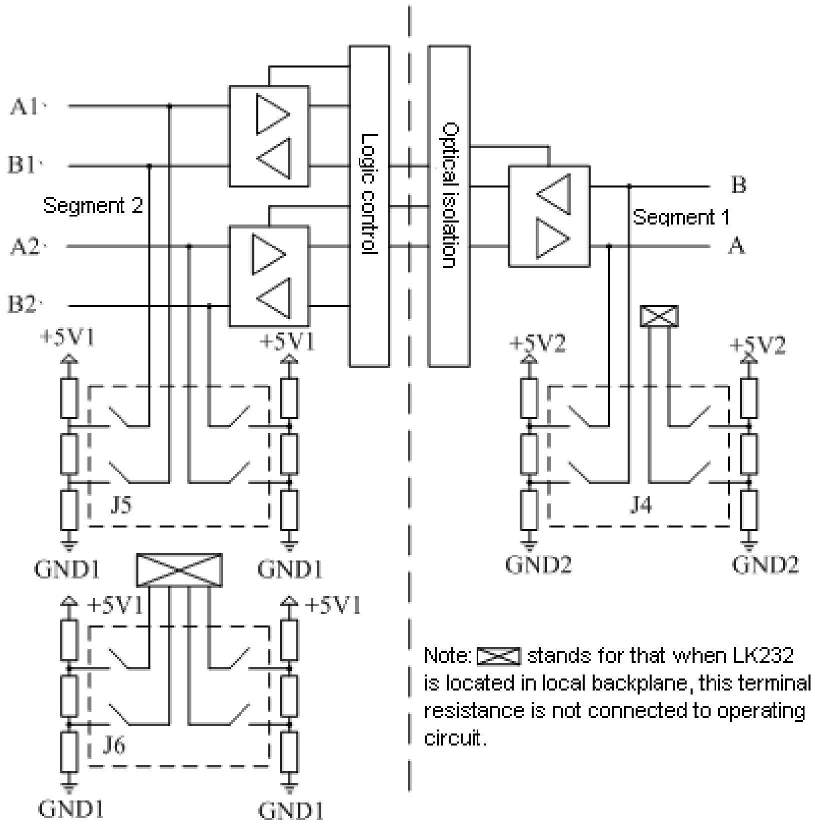


Figure 4.8: Bus interconnection when LK232 is installed on the local backplane

- To avoid the propagation of inferences on the entire bus, two segments of DP bus can be isolated using a DP repeater.
- There is a dip switch inside each LK232 modules, where the dip switch can be used to configure if an active termination resistor is connected to the DP bus. The factory default setting is that the termination resistor is disconnected.
- When used to extend the physical length of a bus, the LK232 module should be installed in the left-most communication slot of the expansion backplane. When used to change the topology of a bus, the LK232 module should be installed in the left-most communication slot of the local backplane.
- The mechanic key for LK232 modules is A5 on both local backplanes and expansion backplanes.

4.2.3 Termination Resistors of LK232

LK232 modules have built-in termination dip switches (J4, J5 and J6), as shown in Figure 4.9, where the dip switches are used to choose whether active matching termination resistors will be connected to ProfiBus-DP.

- LK232 modules can be installed on local backplanes, and can also be installed on expansion backplanes. It should be noted that for different types of backplanes, the definitions of the dip switch are different.
- When an LK232 module is installed on an expansion backplane, the dip switches J4 and J6 are used to set whether network segment I and segment 2 of the expansion backplane should be connected with a termination resistor, and J5 is fixed to connect to a termination resistor. When it is installed on a local backplane, the dip switches J5 and J4 are used to set if the network segment I and segment 2 of the local backplane should be connected with a termination resistor, and J6 is fixed to be not connected with a termination resistor.

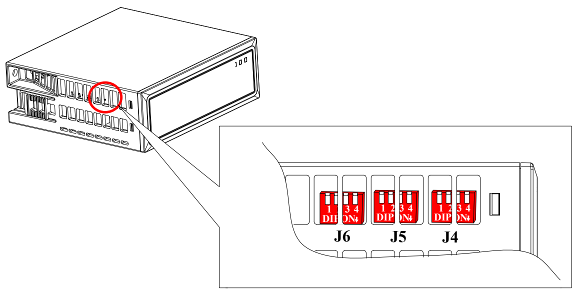


Figure 4.9: Location of the DIP switches of LK232

- The dip switches of LK232 are located inside the module, and the default setting is that termination resistors are not connected. To change the switch positions, it is not necessary to dissemble the casing, instead, use a small flathead screw driver to set the dip switches through the heat dissipation holes, as shown in Figure 4.10.
- When setting the switches, the four keys of each switch must be set consistently. When the four keys are down, the state is "ON", and the termination resistor is connected. When the four keys are up, the state is "OFF", and the termination resistor is disconnected.

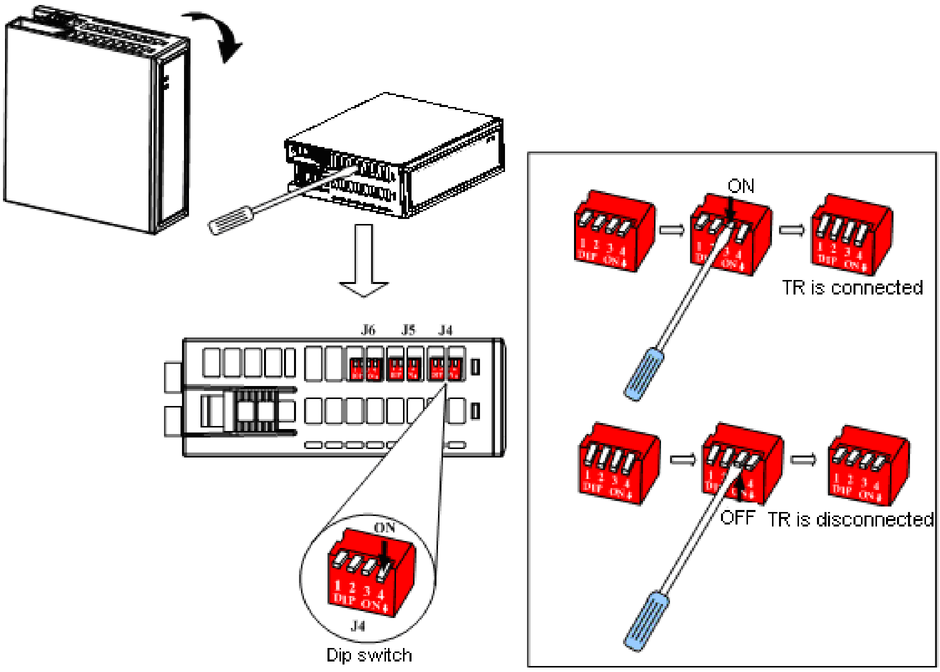


Figure 4.10: DIP switches configuration of LK232

4.2.4 Indicator Definition of LK232

The indicators of LK232 modules are defined as in Table 4.3, where the RUN indicator shows the communication between LK232 and the controller, and the COM indicator shows the communication between LK232 and extension I/O modules.

Indicator	State	Meaning
RUN (Green)	Flash	No data transmitting on segment 1 of ProfiBus-DP
	On	Data transmitting on segment 1 of ProfiBus-DP
	Off	Module not powered on or damaged.
COM(Yellow)	Flash	Data transmitting on segment 2 of ProfiBus-DP. The higher the data volume, the higher the frequency of flashing.
	Off	No data transmitting on segment 2 of ProfiBus-DP.

Table 4.3: Indicator definition of LK232

- *Note: Flash frequency of RUN: ON for 125 ms, and OFF for 125ms.*
- *Flash frequency of COM: Flash once every 30 data packets have been transmitted.*

4.2.5 PROFIBUS-DP Interface

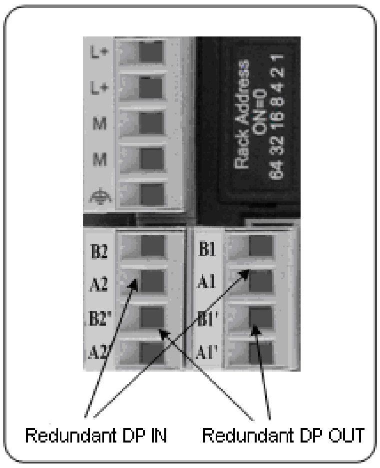


Figure 4.11: PROFIBUS-DP interface on the expansion backplane

Pin Label	Signal
B1	Segment 1 bus 1 positive input (red wire of DP cable)
A1	Segment 1 bus 1 negative input (green wire of DP cable)
B2	Segment 1 bus 2 positive input (red wire of DP cable)
A2	Segment 1 bus 2 negative input (green wire of DP cable)
B1’	Segment 2 bus 1 positive output (red wire of DP cable)
A1’	Segment 2 bus 1 negative output (green wire of DP cable)
B2’	Segment 2 bus 2 positive output (red wire of DP cable)
A2’	Segment 2 bus 2 negative output (green wire of DP cable)

Table 4.4: Wiring terminal definitions of LK232 on expansion backplanes

Note: Network segments 1 and 2 are electrically isolated.

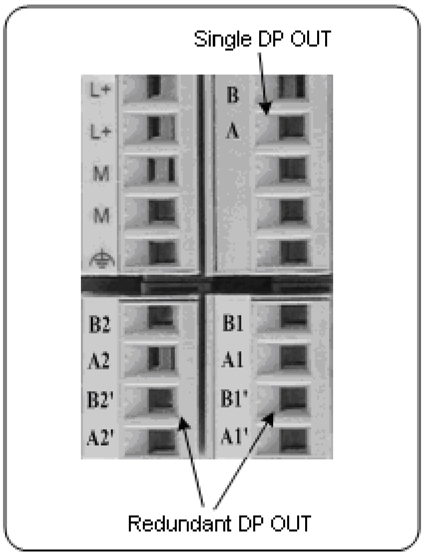


Figure 4.12: PROFIBUS-DP interface on the local backplane

Pin Label	Signal
B1	Nil
A1	Nil
B1'	Segment 1 bus 1 positive output (red wire of DP cable)
A1'	Segment 1 bus 1 negative output (green wire of DP cable)
B2	Nil
A2	Nil
B2'	Segment 1 bus 2 positive output (red wire of DP cable)
A2'	Segment 1 bus 2 negative output (green wire of DP cable)
B	Network segment 2 positive output (single DP)
A	Network segment 2 negative output (single DP)

Table 4.5: Wiring terminal definitions of LK232 on local backplanes

Note: Network segments 1 and 2 are electrically isolated.

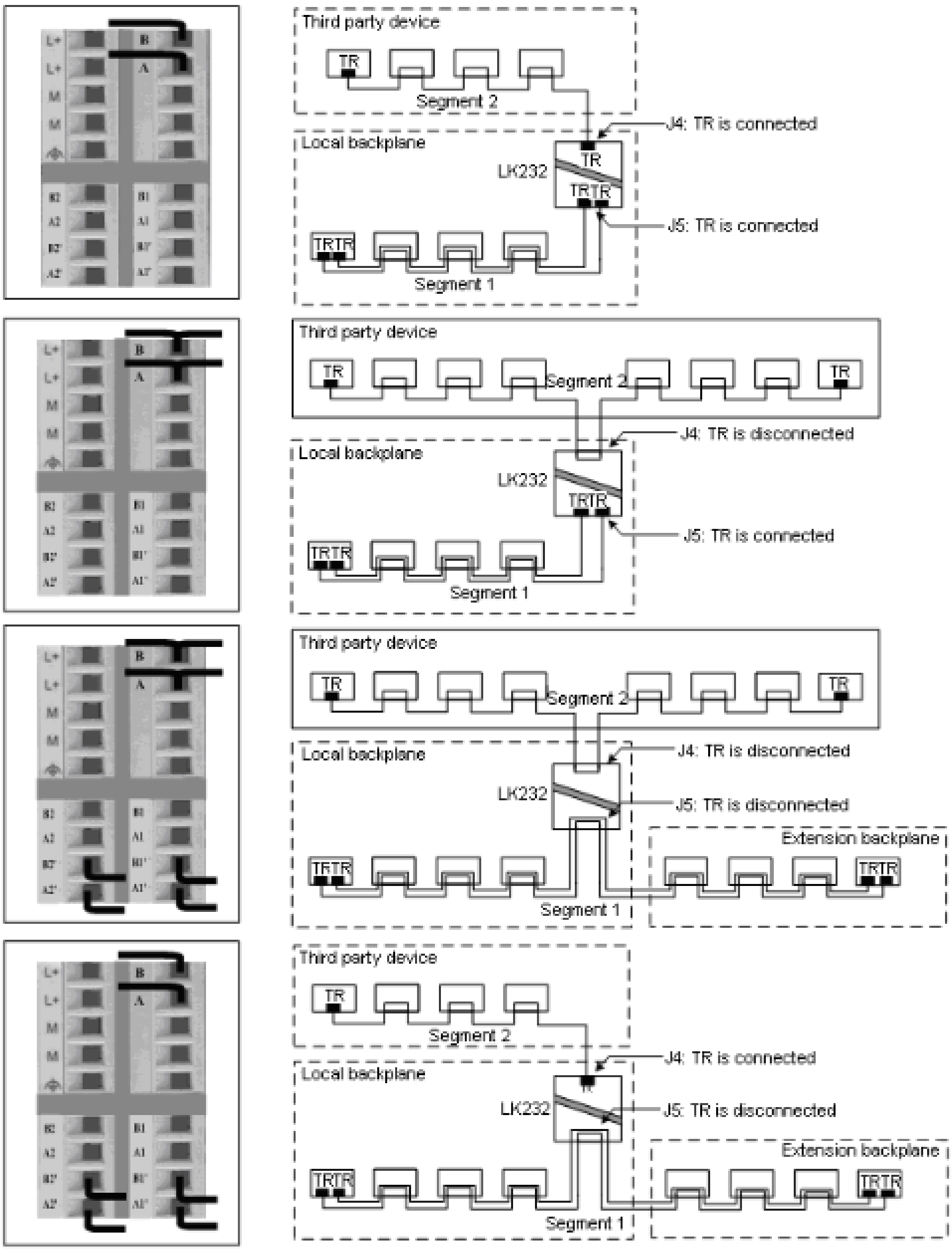


Figure 4.13: Termination matching of LK232 on local backplanes

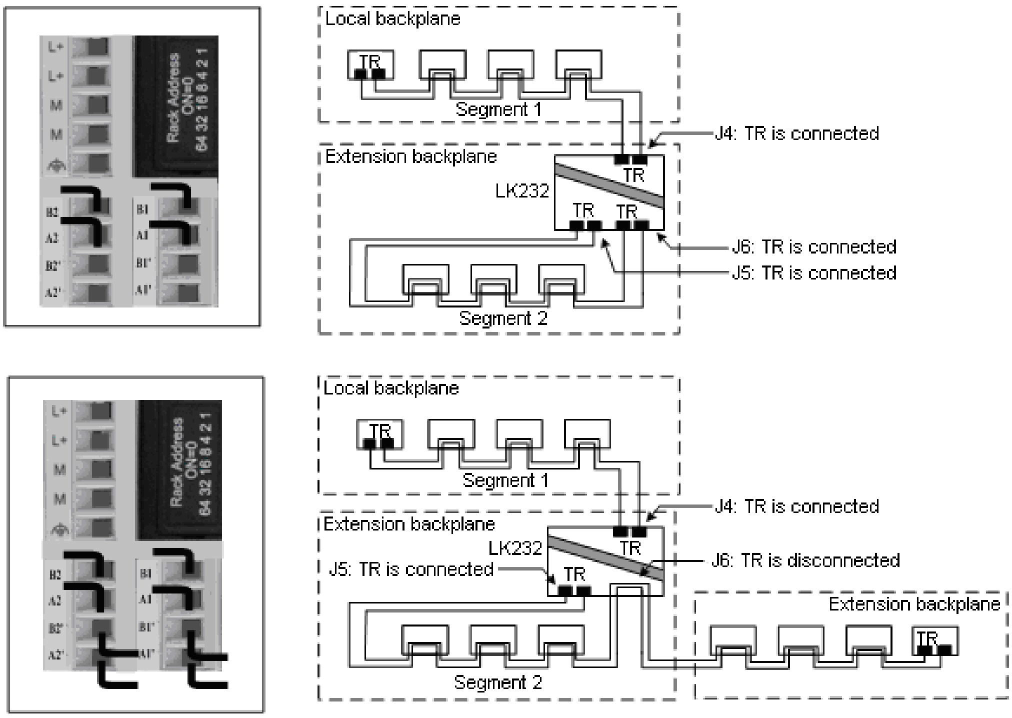


Figure 4.14: Termination matching of LK232 on expansion backplanes

4.2.6 Typical Applications of LK232

Typical application of LK232 DP-bus repeaters are as illustrated in Figure 4.15 and Figure 4.16. In the actual design, it has to be noted that:

- In a star topology, the termination resistor dip switch has to be set to open at the branching point, that is, the termination resistor has to be disconnected from the repeater.
- LK112 backplanes are expansion backplanes with a termination resistor, and termination resistor should not be configured for these backplanes. In addition, do not extend the ProfiBus-DP from LK112 to other expansion backplanes.
- Termination resistors have to be added at the end of each branch.

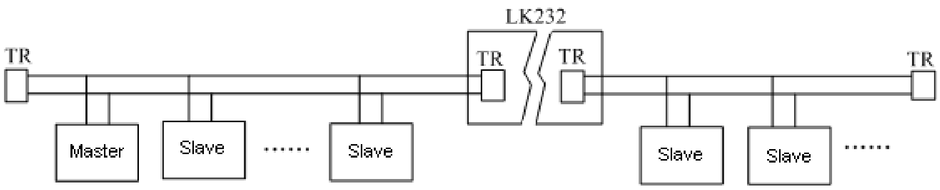


Figure 4.15: LK232 is used to extend a bus

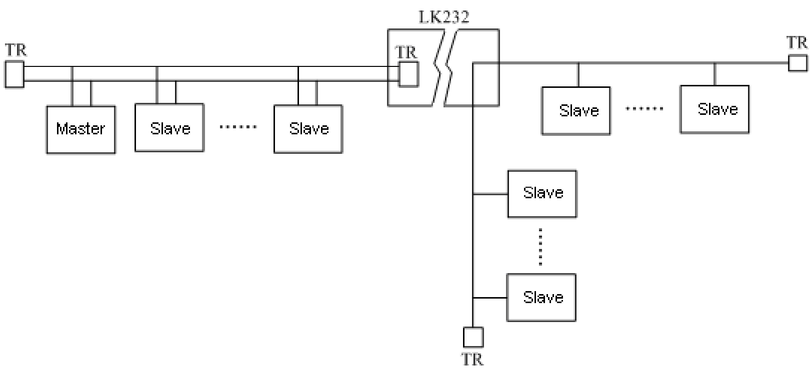


Figure 4.16: LK232 is used to change network topology

4.2.7 Module Installation and Un-installation

Refer to chapter 1 on "Module Insertion Mechanical keys" and "Module Insertion and Removable" for more details.

4.2.8 Technical Specifications of LK232

LK232 ProfiBus-DP bus repeater		
Backplane power supply		
Input Voltage		24VDC (-15% ~ 20%)
Power Consumption		60mA max@24VDC
Isolation Voltage		
Network segments 1 and 2		500VAC test for 1 min, current leakage 5mA
Communication		
Protocol		ProfiBus-DP
Dual Network Redundancy		Supported
Communication Rate		9.6Kbps, 19.2Kbps, 31.25Kbps, 45.45Kbps, 93.75Kbps, 187.5Kbps, 500Kbps and 1.5Mbps adaptive
Physical features		
Indicator	RUN	Green
	COM	Yellow
Installation method		Slot installation
Installation location		Communication slots on LK local backplanes and expansion backplanes
Mechanic keys that prevent incorrect insertion		A5
Dimension (Width * height * depth)		35mm x 100mm x 100mm
Hot swap		Supported
Working Environment		
Working Temperature		0℃~60℃
Working Relative Humidity		5%~95%, no condensate
Storage Temperature		-40℃~70℃
Storage relative humidity		5%~95%, no condensate

Figure 4.17: Technical Specification of LK232

4.3 LK250 [PROFIBUS-DP NETWORK EXTENSION MODULE]

LK250 is a network extension module for ProfiBus-DP, and is installed on the left-most slot of expansion backplanes only.

4.3.1 Features of LK250

- Interconnect ProfiBus-DP slave stations to ProfiBus-DP master stations
- Connect at most 30 ProfiBus-DP slave station modules
- Provide termination resistors for ProfiBus-DP
- Used to reduce the number of ProfiBus-DP slave station nodes in the network segment where the controller resides
- Can only be installed on expansion backplanes
- Support hot swap

4.3.2 Operating Principle of LK250

- Since a logical ProfiBus-DP network segment supports at most 127 node addresses (node addresses range from 0 to 126, and the address 127 is used for broadcast), when non-redundant controllers need to be configured to connect to more than 126 DP slave stations, or when the number of DP slave stations connected to redundant controllers is more than 125, LK250 modules can be used to extend the DP logical network segment. Under many scenarios where ProfiBus-PA equipments are used, there are very likely to be more than 126 DP slave stations, since each PA equipment (one I/O channel) will occupy a DP node address after converting to DP through a DP/PA coupler.
- Logically speaking, LK250 uses the DP slave station protocol to connect to the controller, and occupies only one DP node address as seen by the controller, and at the same time it uses the DP master station protocol for extended I/O. Each LK250 may carry at most 30 DP slave station I/O, which form a DP logical network segment. The LK250 extended I/O modules exchange data with the controller through the LK250 module. All extended I/O modules are only one DP node as seen by the controller.
- By combining LK250 and LK231 modules, expansion backplane cascading within the DP network segment managed by the LK250 can be achieved.
- There are jumpers inside LK250, which can be used to configure whether DP bus is connected to an active matching termination resistor network, and the factory default setting is that the termination resistors are disconnected.
- LK250 modules are installed in the left-most communication slots of expansion backplanes, and the mechanic key is B5.

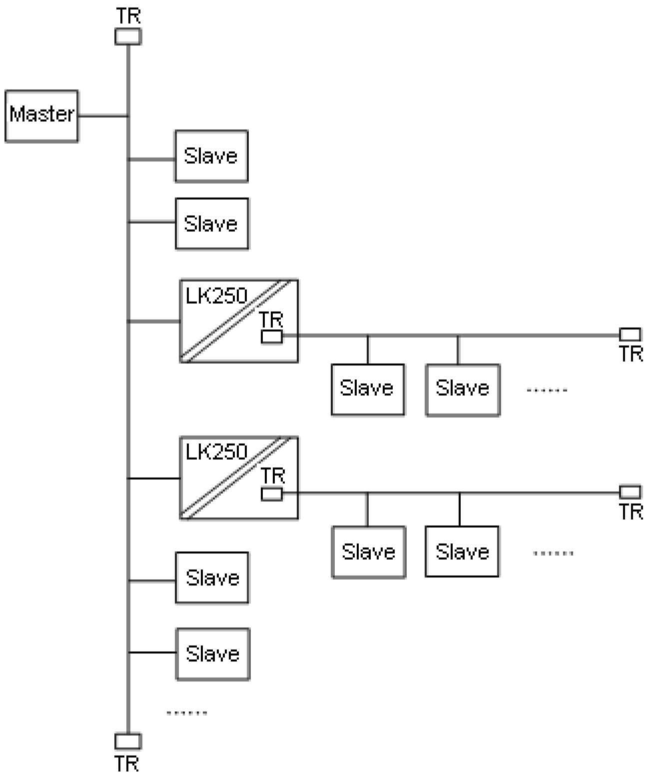


Figure 4.18: LK250 extended slave stations

Notes on termination

- There are two dip switches J4 and J6 on LK250, and through the dip switches it can be configured whether or not to provide active termination resistor networks for DP bus.
- J4: Used to set if the main DP bus is connected to termination resistors. Default is not connected.

- J6: Used to set if the DP bus branch extended by LK250 is connected to termination resistors. Default is not connected.
- The dip switches are located inside the modules, and the default is such that termination resistors are not connected. To change the switch positions, it is not necessary to dissemble the casing, instead, use a small flathead screw driver to set the dip switches through the heat dissipation holes, as shown in Figure 4.19.
- When setting the switches, the four keys of each switch must be set consistently. When the four keys are down, the state is "ON", and the termination resistor is connected. When the four keys are up, the state is "OFF", and the termination resistor is disconnected.

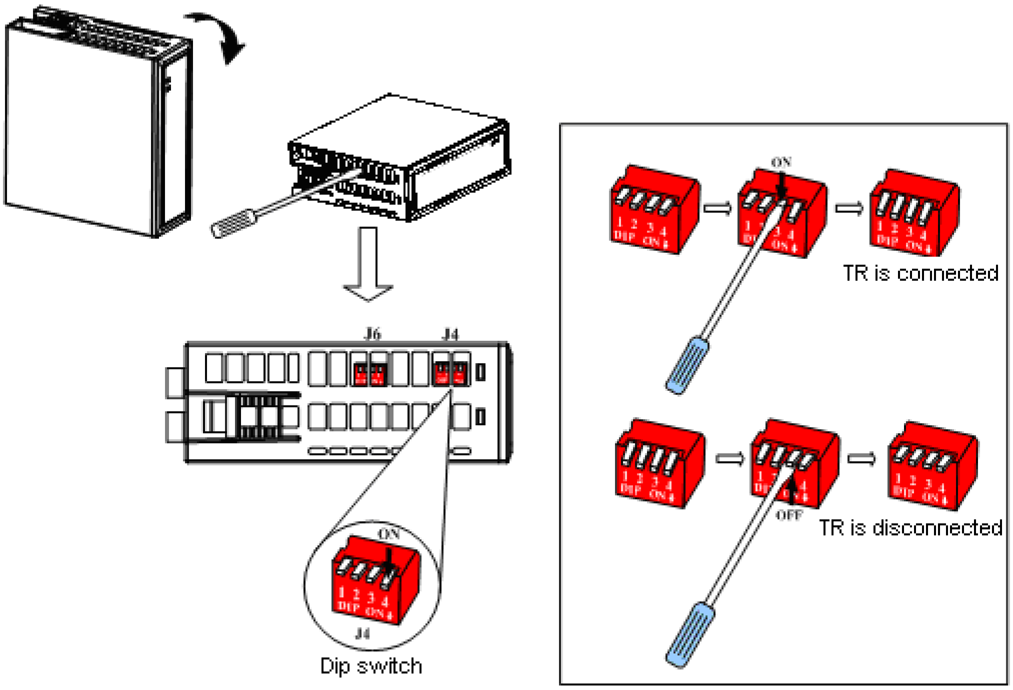


Figure 4.19: Configuration of DIP switches of LK250

4.3.3 Indicator Definition of LK250

The indicators of LK250 modules are defined as in Table 4.6, where the RUN indicator shows the communication between LK250 and the controller, and the COM indicator shows the communication between LK250 and extension I/O modules.

RUN indicator (green)	On	Communication between LK250 and controller is normal
	Flash (On for 125ms and off for 125ms)	When the connection between LK250 and controller has not been established or timed-out
	Off	Not powered on or power failure
COM indicator (yellow)	On	LK250 is communicating normally with one or more I/O
	Flash	LK250 is having problem communicating with all I/O
	Off	No I/O is configured for LK250

Table 4.6: Indicator definition of LK250

4.3.4 Parameter Configuration for LK250

Logically speaking, LK250 acts as a ProfiBus-DP slave station as seen by the controller. Hence, parameters for LK250 must be set as a slave station of the controller, including dialog boxes "DP Parameters", "Input/Output" and "User Parameters". Wherein, the "DP Parameters" are only used to configure the DP slave station address of the LK250 as seen by the controller, as shown in Figure 4.20. This address is the same as the value set by the dip switches of the expansion backplane that LK250 belongs to.

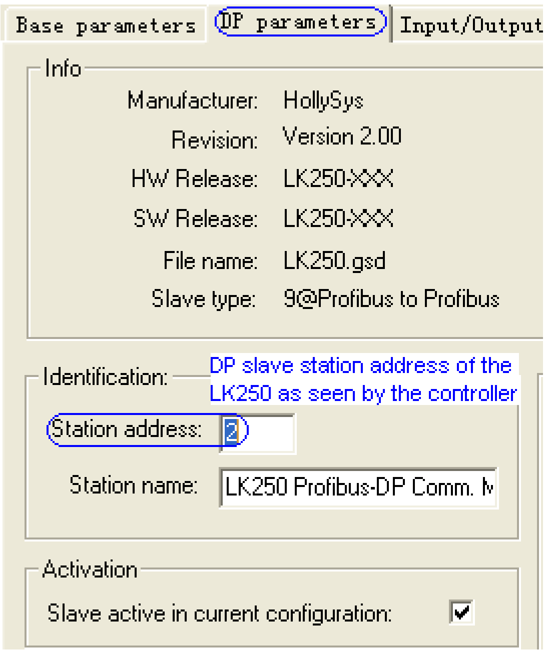


Figure 4.20: LK250 DP slave station address setting

The dip switches at the expansion backplane that LK250 belongs to are used to set the DP slave station address of the LK250 as seen by the controller. When multiple expansion backplanes are cascaded, the dip switch address on every expansion backplane must follow the slot address of the previous expansion backplane, otherwise communications cannot be established. This is illustrated in Figure 4.21.

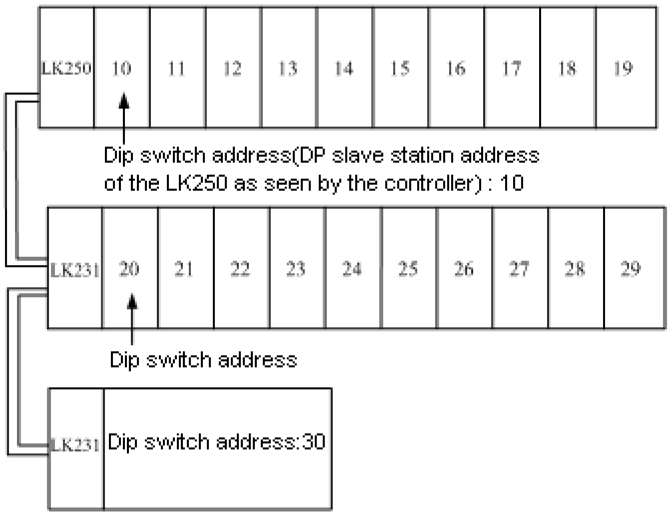


Figure 4.21: Dip switch settings for cascaded expansion backplanes

In the following, we will focus on the "Input/Output" and "User Parameters" settings. These settings together define the following information:

- DP slave stations are installed at node 1 to 30 behind LK250 (configured through user parameters)
- Parameter settings of each DP slave module behind the LK250 (through the input/output settings)

There are three basic steps to configure LK250, which are described as the following:

Plan and calculate the number of DP slave stations attached to LK250

The number of DP slave stations that can be attached to LK250 is determined by the minimum number given by the following three conditions:

- Due to physical and electrical limitations, an LK250 can have at most 30 slave stations.
- The number of slave stations of LK250 cannot be more than 30, and multiple expansion backplanes can be connected serially. The type and number of expansion backplanes can be chosen according to the number of slave stations. LK231 DP communication interconnection modules should be installed on cascaded expansion backplanes.
- The total length of all the user parameters of all the slave stations cannot be more than 239 bytes. Otherwise, the following error message will appear during compilation.

  Error 3452: The module 'Profibus DP Master' could not be created!

Taking LK430 as an example, the length of the user parameters for each LK430 is 36 bytes, hence an LK250 can have at most 239/36 = 6 LK430 modules attached to it. When the number of LK430 modules is greater than 6, there will be an error during compilation.

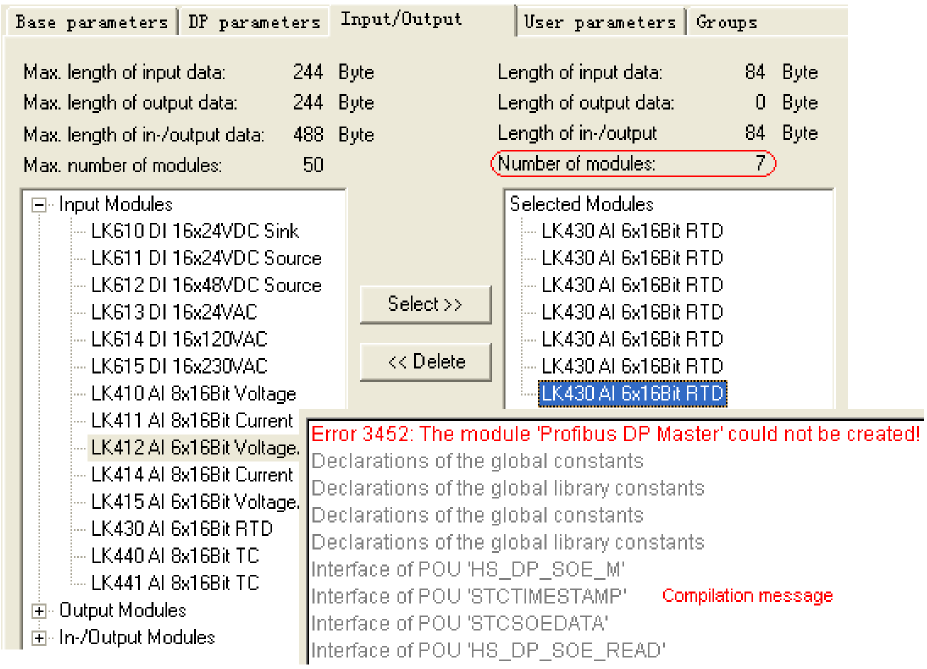


Figure 4.22: Compilation error when the total length of user parameters for LK250 is too large

The total length of the input/output data of all slave stations must not exceed the maximum length (244 bytes) allowed by LK250. If it exceeds, a message box will appear to prompt that the capacity has been exceeded and no more modules will be allowed to be added. Under normal scenarios, the length of the input/output data area will not exceed 244 bytes.

Figure 4.23: Error prompt message box when total input/output length exceeds the capacity of LK250

In sum, electrically an LK250 can only have at most 30 slave stations, and it is required that logically the total length of all the user parameters of all slave stations must not exceed 239 bytes, and at the same time the total length of the input/output data of all slave stations must not exceed 244 bytes. When slave stations are to be allocated for LK250, appropriate module types and numbers must be chosen according to the user parameter lengths of the I/O modules as shown in the following table.

Module	Data length (in bytes)		
	Input data	Output data	User Parameters
LK410	16	0	46
LK411	16	0	46
LK414	16	0	38
LK412	12	0	36
LK415	12	0	36
LK430	12	0	36
LK440	16	0	46
LK441	16	0	49
LK510	0	8	21
LK511	4	8	22
LK610	2	0	2
LK611	2	0	2
LK612	2	0	2
LK613	2	0	1
LK614	2	0	1
LK615	2	0	1
LK630	124	0	3
LK710	2	2	5
LK711	1	1	4
LK712	1	1	4
LK720	1	1	3
LK810	8	4	35

Table 4.7: List of data lengths of LK modules

Setting the types of modules installed on nodes 1 to 30 behind an LK250

- To set the types of the DP slave stations correspond to each node of nodes 1 to 30 behind an LK250, the LK250 "User Parameters" option needs to be configured as shown in Figure 4.25. Right click to choose the module type for each slot, and when a slot is empty or it does not exist, "none" should be chosen. LK250 only supports DP slave stations predefined by HollySys, and does not directly support third party standard DP slave modules.
- There are following rules for slot numbers: The first I/O slot on the expansion backplane where the LK250 module resides is defined as slot 1, and the slot number is incremented from left to right and from top to bottom, up to at most 30. This is illustrated in Figure 4.24. These slots correspond to Slot1 (first slot) to Slot30 (the 30th slot) in the user parameters shown in Figure 4.25.

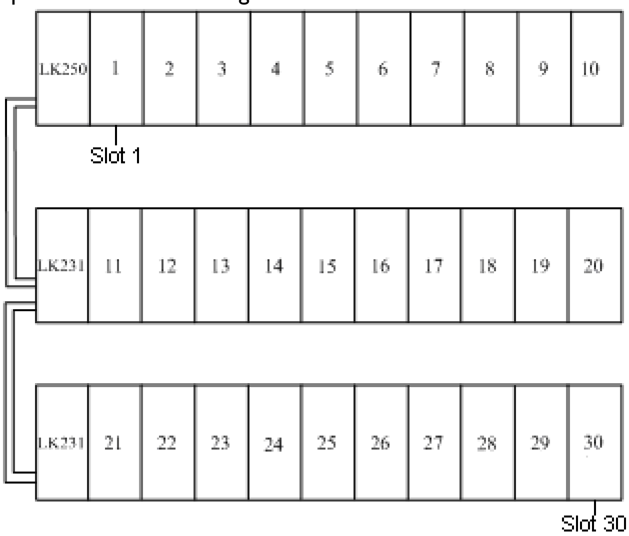


Figure 4.24: LK250 slave station slot number

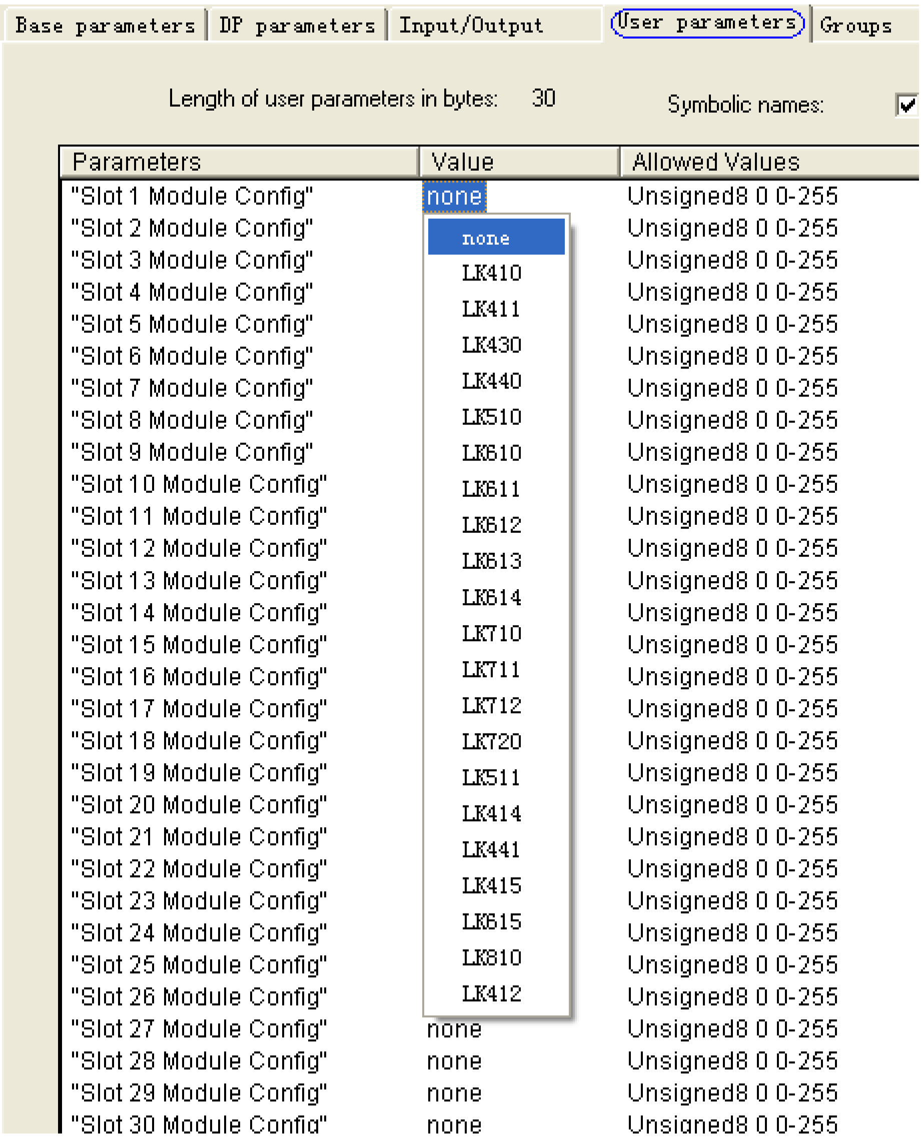


Figure 4.25: LK250 user parameter settings

Set parameters for each DP slave station module attached to LK250

The parameters for every DP slave station attached to LK250 can be set in the “Input/Output” option of LK250, as shown in Figure 4.26, which comprises of two steps: First, add the module, and next, set the module parameters.

Step 1: Adding a module

- The left pane of the dialog box lists all the DP slave modules supported by LK250. It can be seen that LK250 only supports DP slave stations predefined by HollySys, and does not directly support standard DP slave stations from third parties. Choose modules from the list on the left according to the DP slave station list in Step 2 and add them to the list on the right. The type and order of the selected modules must be consistent with the modules installed on the backplane. That is, they must be consistent with the module order in "User Parameters", from the smallest node number to largest. Otherwise communication cannot be established. To remove a module, click on the module in the list and click the “Delete” button, and go back to “User Parameters” option to change the module type on the corresponding slot to “none”.

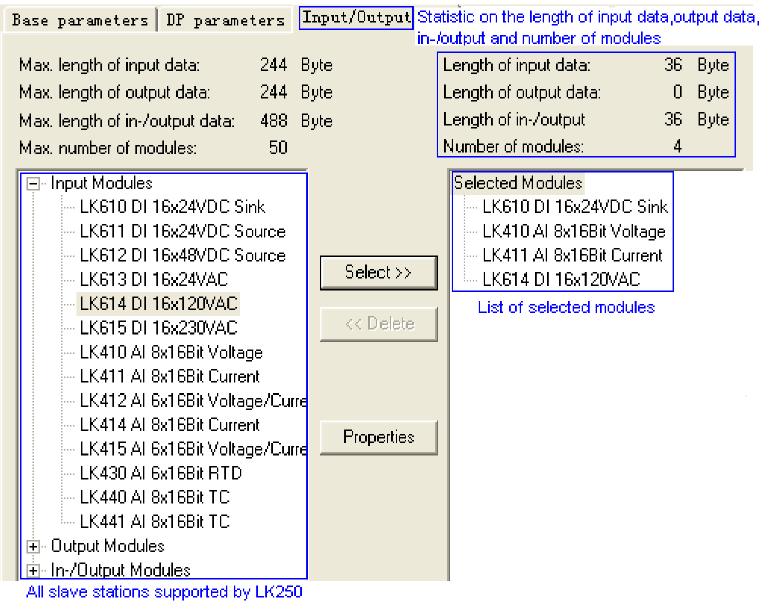


Figure 4.26: LK250 input/output settings

Step 2: Set parameters for each module

As shown in Figure 4.27, on the right of the dialog box, click the module whose parameters need to be set, and click the “Properties” button. The parameter setting dialog box will appear, where it can be seen that the parameter setting dialog box is the same as that when the module is used directly as a DP slave station, and the way to set the parameters is also the same. For parameter definitions and settings, please refer to corresponding part in the user manual for each particular module.

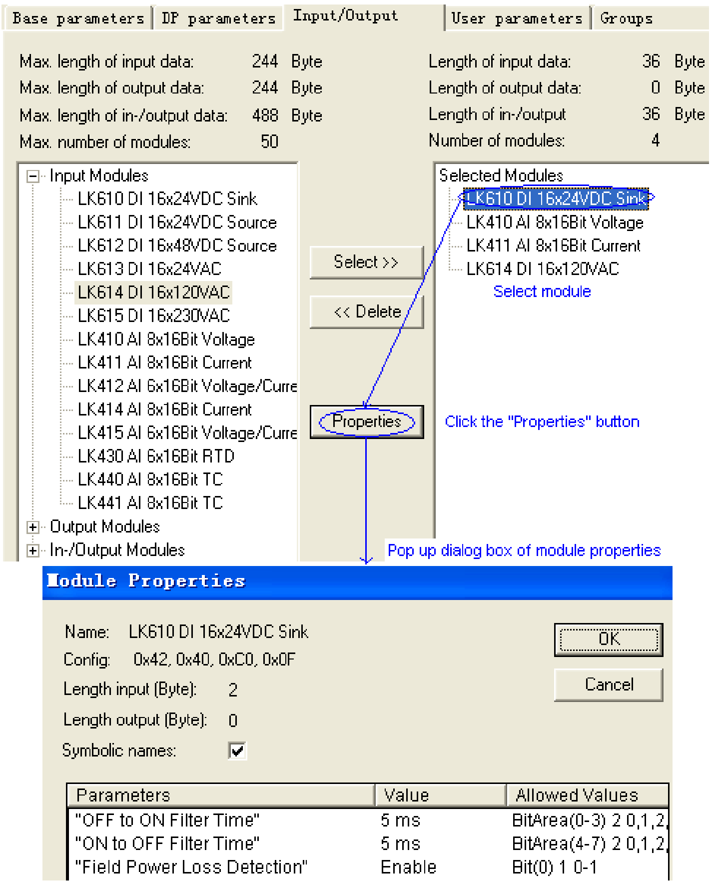


Figure 4.27: Setting parameters for the modules attached to LK250

4.3.5 Module Installation and Un-installation

Refer to chapter I on "Module Insertion Mechanical keys" and "Module Insertion and Removable" for more details.

4.3.6 Technical Specifications of LK250

LK250 ProfiBus-DP Network Extension Module		
System power supply		
Voltage		24VDC (-15% ~ +20%)
Power Consumption		100mA max@24VDC
Processor and memory		
CPU		32 bit micro processor
Memory	SRAM	256KB
	FLASH	2MB
Communication Bus		
Protocol		Interconnection from ProfiBus-DP slave station to ProfiBus-DP master station, compliant with IEC61158-3/EN50170 standard
Slave capacity	Maximum input data length	244 bytes
	Maximum output data length	244 bytes
	Maximum user parameter length	239 bytes
	Number of slave station modules	Physically and electrically at most 30. Logically require all slave station data total length does not exceed 239 bytes, and all slave station input/output data length does not exceed 244 bytes
Communication Rate	DP slave protocol	9.6Kbps, 19.2Kbps, 31.25Kbps, 45.45Kbps, 93.75Kbps, 187.5Kbps, 500Kbps and 1.5Mbps adaptive
	DP master protocol	500Kbps
Communication media hot backup redundancy		Supported
Physical features		
Installation method		Slot installation
Installation location		Communication slots on LK expansion backplanes
Mechanic keys that prevent incorrect insertion		B5
Hot Swap		Supported
Dimensions		Width x height x depth = 35mm×100mm×100mm
Casing protection level		IEC60529 IP20
Weight		170g
Working Environment		
Working Temperature		0℃~60℃
Working relative humidity		5%~95%, non-condensing
Storage temperature		-40℃~70℃
Storage relative humidity		5%~95%, non-condensing

Table 4.8: Technical Specification of LK250

4.4 LK252 [PROFIBUS-DP & MODBUS MASTER COMMUNICATION MODULE]

4.4.1 Features

- Interconnect Modbus slave stations and the controller
- Provide termination resistors for RS485 interface
- Communication mode: RTU/ASCII configurable
- Provide termination resistors for ProfiBus-DP
- Communication interface: RS485/RS232 configurable
- Installed on communication slots on local backplanes
- Support hot swap

- LK252 is a Modbus communication interface extension module, which supports high speed bus protocols and Modbus protocol, exchanges data with controllers through a high speed bus, and obtains and distributes data for Modbus slave stations as a Modbus master station. It supports function codes 01, 02, 03, 04, 05, 06, 07, 08, 11, 12, 15 and 16.
- The Modbus protocol is a master-slave communication protocol. As a master station, an LK252 can connect at most 31 slave stations. LK252 accomplishes communication through the asynchronous serial port on the backplane, where the physical layer uses either RS485 or RS232 (not both), and the transmission rate can be as high as 115.2kbps. It supports either RTU mode or ASCII mode (not both).
- The Modbus communication employs a poll-response model. The poll-response model is such that the master station issues a command to a slave station, and waits for response from the slave station. The slave station, upon receiving the command from the master station, executes the command, returns the result of the execution as a response to the master station, and waits for the next command. The time interval between when the master station issues a command and when the slave station responds is called the time-out period, which can be configured through the module parameter "TIME_OUT".
- LK252 modules are installed in the left-most communication slots of local backplanes, and the mechanic key is C5.

4.4.2 Indicator Definition

The indicators of LK252 modules are defined as in Table 4.9, where the RUN indicator shows the communication between LK252 and the controller, and the COM indicator shows the communication between LK252 and Modbus slave stations.

RUN indicator (green)	On	Communication between LK252 and controller is normal
	Flash (On for 125ms and off for 125ms)	When the connection between LK252 and controller has not been established or timed-out
	Off	Power Off or Module Failure
COM indicator (yellow)	On	LK252 is communicating normally with one or more Modbus slave stations
	Flash	LK250 is having problem communicating with all Modbus slave stations
	Off	No Modbus slave station is configured for LK252

Table 4.9: LK252 Status Indicator Definition

4.4.3 Wiring Specifications

RS485 interface

When RS485 interface is chosen, the module parameter "RS232-485" has to be set as "RS485". The communication terminal of LK252 is located on the local backplane. The definitions of RS485 pin signals are as shown in Table 4.10, and the wiring method is as shown in Figure 4.28.

Communication interface	Pin Label	Signal
RS485	D+	485+
	D-	485-
RS232	T	TXD (send data)
	R	RXD (receive data)
	⏚	RS232 ground reference

Table 4.10: LK252 Communication terminal signal definition

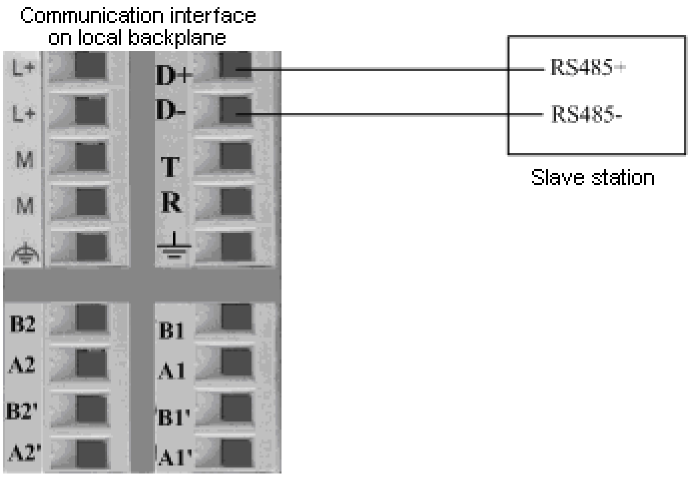


Figure 4.28: Wiring of RS485 for LK252

RS232 interface

When RS232 interface is chosen, the module parameter "RS232-485" has to be set as "RS232". The communication terminal of LK252 is located on the local backplane. The definitions of RS232 pin signals are as shown in Table 4.10, and the wiring method is as shown in Figure 4.29.

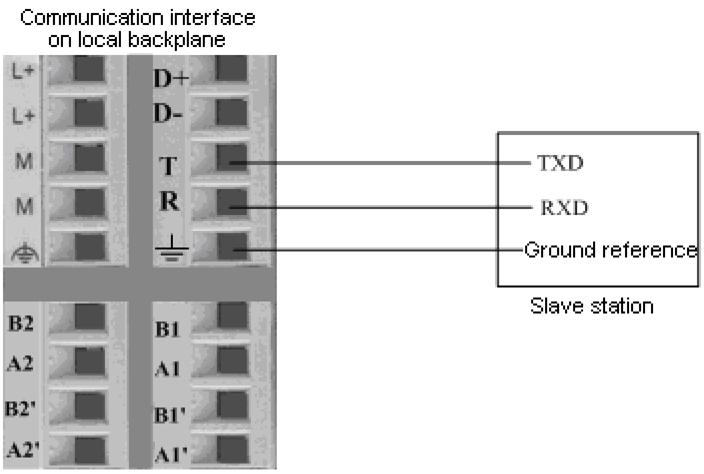


Figure 4.29: Wiring of RS232 for LK252

4.4.4 Function Code Specifications

Function codes are used to notify slave stations which function to be executed. Table 4.11 lists the meanings and effects of Modbus function codes that are supported by LK252. Users can set the function codes of slave stations through module parameter "Func_code". Besides function codes, each slave station also needs three parameters to be configured to access the slave station data, namely, slave station address, starting address and data length, as shown in Table 4.12.

Function code		Meaning	Function
01	Read DO	Read digital output status (DO read back)	Read back the current status of a group of digital outputs
02	Read DI	Read digital input status (DI)	Obtain the current status of a group of digital inputs
03	Read AO	Read analog output status (AO read back)	Read back the current status of a group of analog outputs
04	Read AI	Read analog input status (AI)	Obtain the current status of a group of analog inputs
05	Force single DO	Force single digital output (single DO)	Forcedly set the value of a certain digital output
06	Force single AO	Force single analog output (single AO)	Forcedly set the value of a certain analog output
15	Force multiple DO	Force multiple digital outputs (multiple DO)	Forcedly set the values of multiple consecutive digital outputs
16	Force multiple AO	Force multiple analog outputs (multiple AO)	Forcedly set the values of multiple consecutive analog outputs
07	Read exception status	Read exception status	Obtain a certain status (8 bits) from slave station
08	Test slave	Return diagnostic check	Send a diagnostic check packet to the slave station. Only level two code 00 is supported.
11	Comm event counter	Read communication event counter	Obtain communication status and the number of times communication events happened
12	Comm event log	Read communication event log	Obtain communication status, number of times communication events happened and at most 64 events.

Table 4.11: List of Modbus function codes supported by LK252

Parameter Name	Parameter Specifications	Parameter Length
Slave_adr	Slave station address	1 byte
Func_code	Function code	1 byte
Start_adr	Starting address of data	1 word (2 bytes)
Data_len	Data Length	1 word (2 bytes)

Table 4.12: Slave station parameters for LK252

Function code 01 – DO read back

- Function: read back the status of digital outputs
- Starting address: starting address of bits (The addresses of registers start from 0)
- Data length: total data length in bits

This function code allows LK252 obtain the state of the digital output of the addressed slave station. The starting address (starts from 0) specifies which digital output should be started with, and the data length specifies how many digital outputs should be read. The maximum allowed amount of data is 251 bytes, and each variable in digital outputs occupies one bit. In other words, at most 2008 DO points can be read.

Read back parameter itself occupies a group of slave station information. The following example is to read the states of registers 00015 to 00030 of the digital output slave station at address 6.

Name	Value	Default	Min.	Max.
Slave_adr	6	0	0	63
Func_code	01 read DO	01 read DO		
Start_adr	14	0	0	65535
Data_len	16	0	0	65535

Function code 02 – Read DI

- Function: read back the status of digital inputs
- Starting address: starting address of bits
- Data length: total data length in bits

This function code allows LK252 obtain the state of the digital inputs of the addressed slave station. The starting address specifies which digital input should be started with, and the data length specifies how many digital inputs should be read. The maximum allowed amount of data is 251 bytes, and each variable in digital inputs occupies one bit. In other words, at most 2008 DI points can be read.

The DI parameter occupies a group of slave station information. The following example is to read the states of registers 00025 to 00040 of the digital input slave station at address 7.

Name	Value	Default	Min.	Max.
Slave_adr	7	0	0	63
Func_code	02 read DI	01 read DO		
Start_adr	24	0	0	65535
Data_len	16	0	0	65535

Function code 03 – AO read back

- Function: read back the data from analog outputs
- Starting address: starting address of words
- Data length: total data length in words (2 bytes)

This function code allows LK252 obtain the values of the analog outputs of the addressed slave station. The starting address specifies which analog output should be started with, and the data length specifies how many analog outputs should be read. The maximum allowed amount of data is 251 bytes, and each variable in analog outputs occupies 2 bytes. In other words, at most 125 AO points can be read.

Read back parameter itself occupies a group of slave station information. The following example is to read the data of registers 00035 to 00050 of the analog output slave station at address 8.

Name	Value	Default	Min.	Max.
Slave_adr	8	0	0	63
Func_code	03 read AO	01 read DO		
Start_adr	34	0	0	65535
Data_len	16	0	0	65535

Function code 04 – Read AI

- Function: read back the data from analog inputs
- Starting address: starting address of words
- Data length: total data length in words (2 bytes)

This function code allows LK252 obtain the values of the analog inputs of the addressed slave station. The starting address specifies which analog output should be started with, and the data length specifies how many analog outputs should be read. The maximum allowed amount of data is 251 bytes, and each variable in analog inputs occupies 2 bytes. In other words, at most 125 AI points can be read.

The DI parameter occupies a group of slave station information. The following example is to read the states of registers 00045 to 00060 of the analog input slave station at address 9.

Name	Value	Default	Min.	Max.
Slave_adr	9	0	0	63
Func_code	04 read AI	01 read DO		
Start_adr	44	0	0	65535
Data_len	16	0	0	65535

Function code 05 – Force single DO

- Function: force the status of one digital output
- Starting address: starting address of bits

This function code allows LK252 force the state of the digital output of the addressed slave station. Any digital output in the slave station can be forced. The starting address specifies which digital output to be forced, and the data length parameter is not used.

The single DO parameter occupies one group of slave station information. The following example shows forcing the state of the digital output point 00015 at slave station with address 6.

Name	Value	Default	Min.	Max.
Slave_adr	6	0	0	63
Func_code	05 force single DO	01 read DO		
Start_adr	14	0	0	65535
Data_len	0	0	0	65535

Function code 06 – Force single AO

- Function: force the status of one analog output
- Starting address: starting address of words

This function code allows LK252 force the data of the analog output of the addressed slave station. Any analog output in the slave station can be forced. The starting address specifies which analog output to be forced, and the data length parameter is not used.

The single AO parameter occupies one group of slave station information. The following example shows forcing the data of the analog output point 00035 at slave station with address 8.

Name	Value	Default	Min.	Max.
Slave_adr	8	0	0	63
Func_code	06 preset single AO	01 read DO		
Start_adr	34	0	0	65535
Data_len	0	0	0	65535

Function code 15 – Force multiple DO

- Function: force the states of multiple digital outputs
- Starting address: starting address of bits
- Data length: total data length in bits

This function code allows LK252 force the states of a group of consecutive digital outputs of the addressed slave station. Any consecutive digital outputs in the slave station can be forced. The starting address specifies which digital input should be started with, and the data length specifies how many digital outputs should be forced. The maximum allowed amount of data is 247 bytes, and each variable in digital outputs occupies one bit. In other words, at most 1976 DO points can be forced.

The multiple DO parameters occupy one group of slave station information. The following example shows forcing the states of the registers 00015~00030 at slave station with address 6.

Name	Value	Default	Min.	Max.
Slave_adr	6	0	0	63
Func_code	15 force multiple DO	01 read DO		
Start_adr	14	0	0	65535
Data_len	16	0	0	65535

Function code 16 – Force multiple AO

- Function: force the data of multiple analog outputs
- Starting address: starting address of words
- Data length: total data length in words (2 bytes)

This function code allows LK252 force the data of a group of consecutive analog outputs of the addressed slave station. Any consecutive analog outputs in the slave station can be forced. The starting address specifies which analog output should be started with, and the data length specifies how many analog outputs should be forced. The maximum allowed amount of data is 247 bytes, and each variable in analog outputs occupies 2 bytes. In other words, at most 123 AO points can be forced.

The multiple AO parameters occupy one group of slave station information. The following example shows forcing the data of the registers 00035~00050 at slave station with address 8.

Name	Value	Default	Min.	Max.
Slave_adr	8	0	0	63
Func_code	16 preset multiple AO	01 read DO		
Start_adr	34	0	0	65535
Data_len	16	0	0	65535

Function code 07 – Read exception status

- Function: read exception events of 1 byte (8 bits) from slave station

The starting byte of the event is determined by the slave station. Hence the starting address and data length parameters do not need to be set.

Function code 08 – Return diagnostic check

- Function: Returns a diagnostic check packet to the slave station
- Starting address: starting address of words
- Data length: total data length in words

The only supported diagnostic code is “0000”.

Function code 11 – Read communication event counter

- Function: read communication status and communication event counter
- Starting address: starting address of words
- Data length: 2 byte communication status and 2 byte event count

Function code 12 – Read communication event log

- Function: read communication status, event counter, message counter and event.
- Starting address: starting address of words
- Date length: 2 bytes of communication status, 2 bytes of event count, 2 bytes of message count and at most 64 bytes of events.

4.4.5 Diagnostics Specifications

When a slave station finds an error in the request packet from the master station (for example, slave station address, starting address or data length parameters are wrong), the slave station will set the highest bit (bit 7) of the function code in the response packet to 1, and at the same time sends a one byte error code. Error code 1~7 represents different error types, where the details can be found in Table 4.13.

A response packet containing an error code will include: 1 byte of slave station address + 1 byte of function code (with highest bit set) + 1 byte of error code (0~7) + 2 bytes of CRC.

The following example is the error message returned from an analog input slave station with address 9, indicating that data length setting is wrong.

- 09H Slave station address
- 84H Function code
- 03H Error code
- **H Lower byte of CRC
- **H Higher byte of CRC

Error code	Meaning	Cause
1	Invalid function code	Function code is not supported by the slave station
2	Invalid data address	Incorrect data starting address setting
3	Data out-of-range	Incorrect setting for data length
4	Error connecting devices	Slave device fault
5	Request acknowledgement	Slave needs longer time to process. Acknowledge receiving the request.
6	Busy, request denied	Slave device busy
7	Request received but not acknowledged	Request will not be executed

Table 4.13: List of LK252 exception status error code

After receiving an error code, the user should take corresponding measures according to the error type, and resend the request.

Data Description

As shown in Figure 4.30, choose "Local Bus" high speed backplane bus link and add "LK252 Modbus" in the Local Bus link in the PowerPro V4 configuration software.

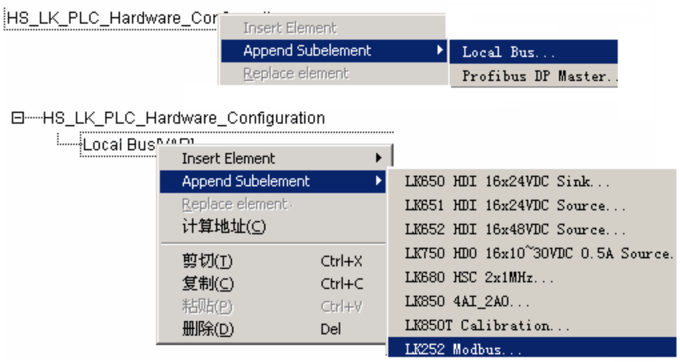


Figure 4.30: Adding LK252 module in configuration software

After adding LK252, all its input/output data can be listed, as shown in Figure 4.31, where the output data is in front, and input data is at the back, sorted according the byte, and each area can have at most 280 bytes. Each analog variable occupies 2 bytes (a word, 0~65535). Each digital variable occupies 1 bit of a byte, starting from bit 0, and the remaining higher bits are filled with 0.

Through the I/O data area, LK252 reads the input states from slave stations (digital, analog, read back) and forces values for outputs (digital and analog).

The number of Modbus slave stations that can be attached to an LK252 is determined by the minimum number given by the following two conditions:

Physically, the total number of LK252 slave stations cannot be more than 31, and the addresses of slave stations range from 1 to 31.

The total length of all the input data from all slave stations cannot be more than 128 words, and the total length of all the output data cannot be more than 128 words.

Data Type	Data Name	Data definition
Output data (QW, 128 words)	O_Data0	Output data 0, double byte, 1 analog variable (0~65535) or 16 digital variables (bit 0 to bit 15)
	O_Data1	Output data 1
	……	……
	O_Data127	Output data 127
Input data (IW, 128 words)	Data0	Input data 0
	I_Data0	Input data 1
	……	……
	I_Data127	Input data 127

Table 4.14: List of LK252 input/output data

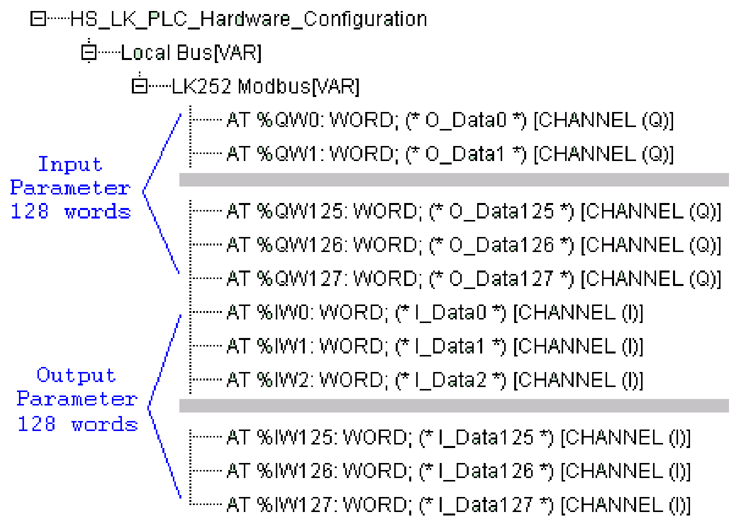


Figure 4.31: LK252 input/output data

4.4.6 Parameter Specifications

Communication parameters

LK252 is installed on the communication slot (left-most slot) of the LK local backplane, and can only communicate with the controller after the communication address has been specified. The communication address of the LK252 module is set to 10, as shown in Figure 4.32.

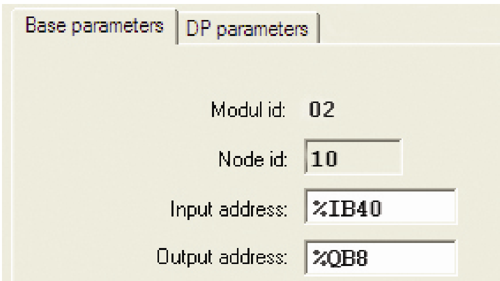


Figure 4.32: Configuring the Communication Address of LK252

Module Parameters

Module parameters are used to configure the working mode of LK252, which will be written into the controller when the user program is downloaded, and will not necessarily be read during each scan cycle. Each parameter has a default value, which can be changed according to the need of the project. Module parameters cannot be modified online. After modifications, they will be effective only after a full download.

There are two parts of LK252 module parameters, as shown in Table 4.15. The first part is the configuration area for communication parameters, which is used to set the communication interface, baud rate, transmission mode, and parity check of the Modbus, where users need to choose appropriate communication parameters according to the types of slave station devices. The second part is a linked list of slave stations. The slave station linked list of LK252 contains 31 groups of slave station information, where each group contains: 1 byte of slave station address (Slave_adr) + 1 byte function code (Func_code) + 2 bytes of starting address of data (Start_adr) + 2 bytes of data length (Data_len).

The function of the slave station address is to specify which slave station device is the one that is currently communicating with the master station. Users must assign a unique slave station address for every slave station. Only correctly addressed slave stations can establish communication with LK252, and respond to the command from LK252.

Each slave station may have multiple function codes (such as output and read back), which occupy multiple groups of slave station information. The total length of input data (or output data) of all slave stations must not exceed 128 bytes. *For details on function codes, please refer to the "Function Code Specification" on each module.*

The starting address specifies the address of the starting register of the data, that is, the place to start reading or writing data. The register addresses start from 0. For example, registers 1~16 have addresses 0~15.

The data length specifies the length of the data field to be read or written, which indicates how many analog or digital data will be processed. The unit of the length is the same as that of the data type.

Parameter definition	Parameter Name		Parameter value
Communication parameters	RS232_485		Communication interface options: = RS232 interface (default); = RS485 interface
	BDRCON		Baud rate (bps) options: ＝2400; ＝4800; ＝9600 (default); ＝19200; ＝38400; ＝57600; ＝115200
	MODE		Transmission mode options = RTU (default); = ASCII
	PARITY		Parity check options = none, no parity check (default); = even, even parity; = odd, odd parity
	TIME_OUT		Time-out value, range: 0~255, default is 0, time base is 100ms For example, if this value is 2, then the time-out is 2 x 100ms =200ms.If a slave station has not responded after 200ms, it will be deemed as offline.
	TURN_AROUND		Minimum turn-around time, range: 0~255, default is 0, time base is 100ms For example, if this value is 100, then the minimum turn-around time is 100 x 100ms = 10000 ms.
Slave station linked list (31 groups)	Group 1	Slave_adr	Slave addresses range from 1 to 31, the default is 0, meaning no slaves.
		Func_code	Function code, valid values: 01, 02, 03, 04, 05, 06, 07, 08, 11, 12, 15, 16. *Refer to Table 4.11 for more details.*
		Start_adr	Starting address of data. Rage: 0~65535. Default is 0.
		Data_len	Data length. Rage: 0~65535. Default is 0. Function code 01, 02, 05, 15. Unit: bit. Function code 03, 04, 06, 16. Unit: word (16 bits).
	…	……	……
	Group 31	Slave_adr	Slave station address
		Func_code	Function code
		Start_adr	Starting address of data
		Data_len	Data length

Table 4.15: LK252 module parameter list

4.4.7 Termination

LK252 modules have two built-in termination dip switches (J4 and J5), as shown in Figure 4.33, where the dip switches are used to choose whether active matching termination resistors will be connected to ProfiBus-DP and RS485 interface.

- J4: Used to set if the RS485 interface is connected to termination resistors. Default is connected.
- J5: Used to set if the main DP bus is connected to termination resistors. Default is not connected.

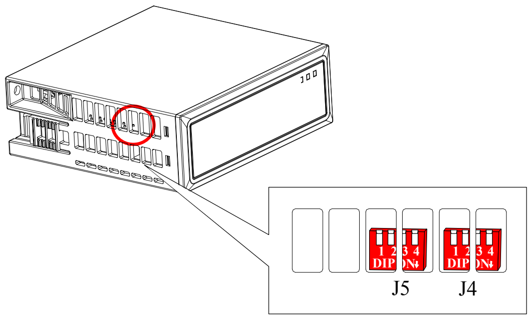


Figure 4.33: Location of dip switches of LK252

LK252 dip switches are located inside the module. The default for J4 is that termination resistors are connected, and the default for J5 is that termination resistors are not connected. To change the switch positions, it is not necessary to dissemble the casing, instead, use a small flathead screw driver to set the dip switches, as shown in Figure 4.34.

When setting the switches, the four keys of each switch must be set consistently. When the four keys are down, the state is "ON", and the termination resistor is connected. When the four keys are up, the state is "OFF", and the termination resistor is disconnected.

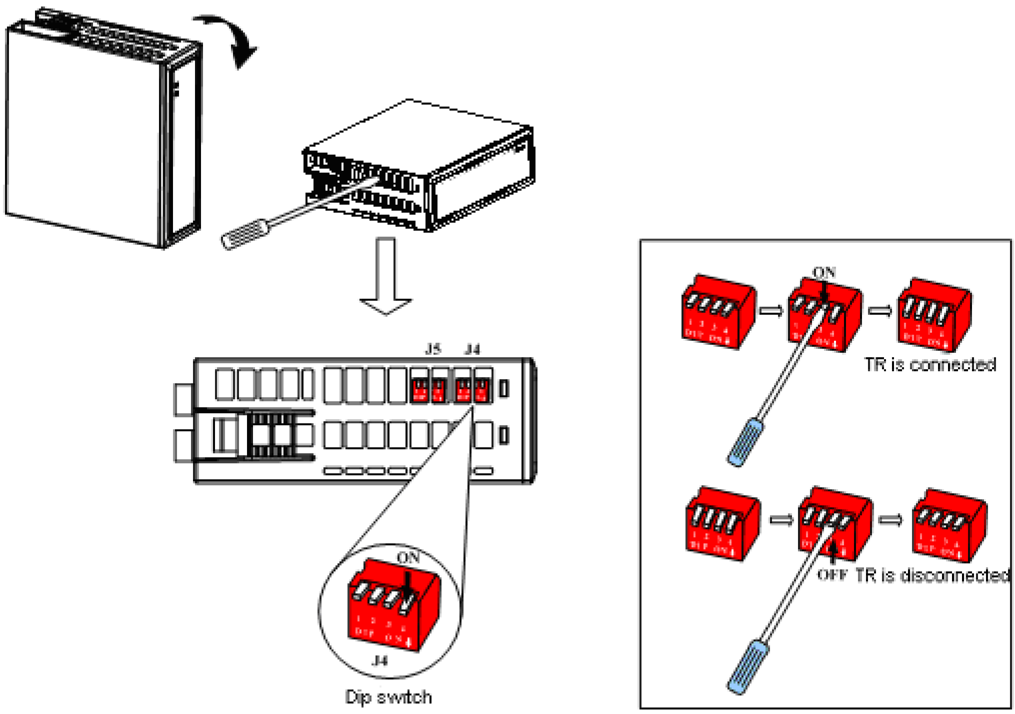


Figure 4.34: Configuration of termination dip switches of LK252

4.4.8 Module Installation and Un-installation

Refer to chapter 1 on "Module Insertion Mechanical keys" and "Module Insertion and Removable" for more details.

4.4.9 Technical Specification

LK252 PROFIBUS-DP & MODBUS MASTER Communication Module	
Backplane power supply	
Input Voltage	24VDC (-15% ~ +20%)
Power Consumption (max)	50mA@24VDC
Communication	
Protocol	High speed bus
	Modbus RTU/ASCII protocols
Function code	1, 2, 3, 4, 5, 6, 7, 8, 11, 12, 15, 16
Data Format	Modbus standard format (Modbus_over_serial_line_V1_02). Support standard Modbus master stations. RS232/RS485 interface.
Maximum number of slaves	31
Input/output data length	At most 128 words each
Communication Rate	115.2kbps, 57.6kbps, 38.4 kbps, 19.2kbps, 9.6kbps, 4.8kbps, 2.4kbps
Physical features	
Installation method	Rack slot installation
Installation location	LK localplane communication slot
Mechanic keys that prevent incorrect insertion	C5
Hot Swap	Supported
Module dimensions	Width x height x depth = 35mm×100mm×100mm
Casing protection level	IEC60529 IP20
Weight	170g
Working Environment	
Working temperature 0~50℃	0℃~60℃
Working relative humidity	5%~95%, no condensate
Storage temperature	-40℃~70℃
Storage relative humidity	5%~95%, no condensate

Table 4.16: Technical Specification of LK252

Chapter 5

CHAPTER 5: ANALOG INPUT MODULE

5.1 COMMON FEATURES

5.1.1 The LED Status indicator

Two LED status indicators can be found on the frontal panel of any analogue I/O module.

- The green color **'RUN'** LED indicator – shows the communication status in-between module and controller
- The yellow color **'CAL'** LED indicator – shows the calibration process of the module. LK analog modules support on the field calibration mode.

RUN indicator (Green)	On	Communication is established
	Flash	Communication is not established or communication error
	Off	Power off of the module
CAL indicator (Yellow)	On	Module is under calibration mode and in calibration or checking
	Flash	Module is under calibration mode but not in calibration or checking
	Off	Power of the module or communication is not established or module is not in calibration mode

Table 5.1: Definition of Analog Module LED Status Indicators

Operation Mode

When the controller is power on, the module needs to initialize and then the green light (RUN) will flash with a frequency of 4 times per second.

After the initialization is completed, the module is in a normal operation and the green light will be constantly on. If any error occurs during the initialization, then it will not be able to establish the communication and the green light will keep on flashing. In this case, you need to check the DP-cable connection and communication parameters settings (communication rate, communication station No) if there are anything wrong with it.

When the module is in normal operation, the green light shall be constantly on. When communication halts, the green light will flash, when communication is re-established, the green light will be back on again.

In normal operation mode, the yellow light (CAL) should always be off.

	RUN light	CAL light	Definition
Operation Mode	Off	Off	Power off
	Flash	Off	Communication is not established or communication error
	On	Off	Communication is established, module working normally

Table 5.2: Definition of LED Status Indicators in Operation Mode

Calibration Mode

When the controller is power on, the module needs to initialize and then the green light (RUN) will flash with a frequency of 4 times per second.

After the initialization is completed, the module is in a normal operation and the green light will be constantly on. If any error occurs during the initialization, then it will not be able to establish the communication and the green light will keep on flashing. In this case, you need to check the DP-cable connection and communication parameters settings (communication rate, communication station No) if there are anything wrong with it.

When the initialization is completed and the module is waiting for calibration instruction to start its calibrating process. The yellow light will flash with a frequency of 4 times per second, when the calibration program starts. The yellow light will constantly be on which indicates that the module is in the "**calibration mode**". When the calibration is completed, the yellow light will flash again.

During calibration process, the green light (RUN) is always on. If the communication error, the green light will flash. When the communication is re-established, the green light will be back on again constantly.

If the communication is not working, the yellow light (CAL) should be in off state.

<table>
<tr><td rowspan="5">Calibration Mode</td><td>RUN light</td><td>CAL light</td><td>Definition</td></tr>
<tr><td>Off</td><td>Off</td><td>Power off</td></tr>
<tr><td>Flash</td><td>Off</td><td>Communication is not established or communication error</td></tr>
<tr><td rowspan="2">On</td><td>On</td><td>In the Calibration process</td></tr>
<tr><td>Flash</td><td>No calibration or calibrating process is completed</td></tr>
</table>

Table 5.3: Definition of LED Status Indicators in Calibration Mode

5.2 LK410 MODULE [8-CHANNEL VOLTAGE AI]

5.2.1 Features

- 8-channel voltage input
- Measurement Range: 10V/0~10V/0~5V
- Maximum Range: ±10.25V/0~10.25V/0~5.125V
- Support ProfiBus-DP slave station protocol.
- Field calibration
- Over-Limit Alarm
- Over-Range Alarm
- Open-wired Detection
- System-to-Field Isolation
- Supports hot swap

5.2.2 Circuitry Principles of LK410

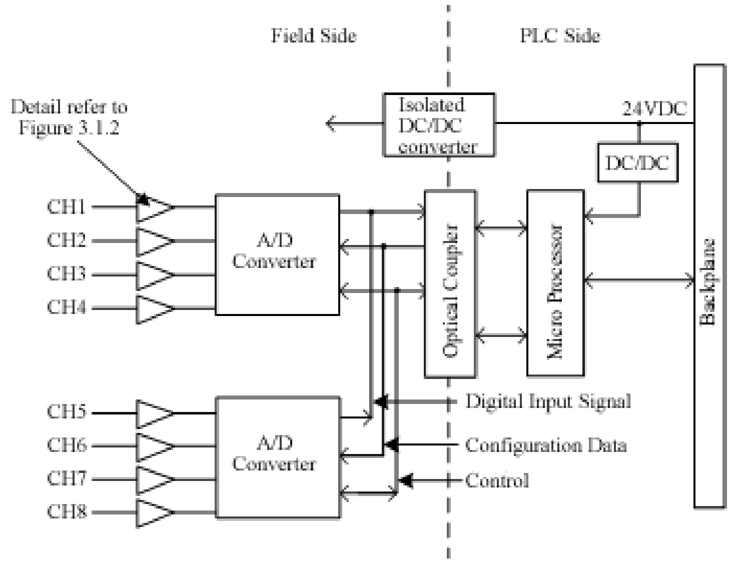


Figure 5.1: Input circuitry of the LK410 Module

As shown in Figure 5.1, the 24V DC system power supply of the LK410 module goes through the isolated DC/DC converter to output a ±15VDC power supply for the field input circuit. This input circuit is connected to other circuits through optical couplers which provide isolation between the field circuit and the system.

As shown in Figure 5.2, the channel interface circuit input voltage signals through voltage conversion, filter and A to D conversion to convert them into digital signals. After the photoelectric isolation, the module micro processor read the signals and uploads them to the controller via the DP-bus.

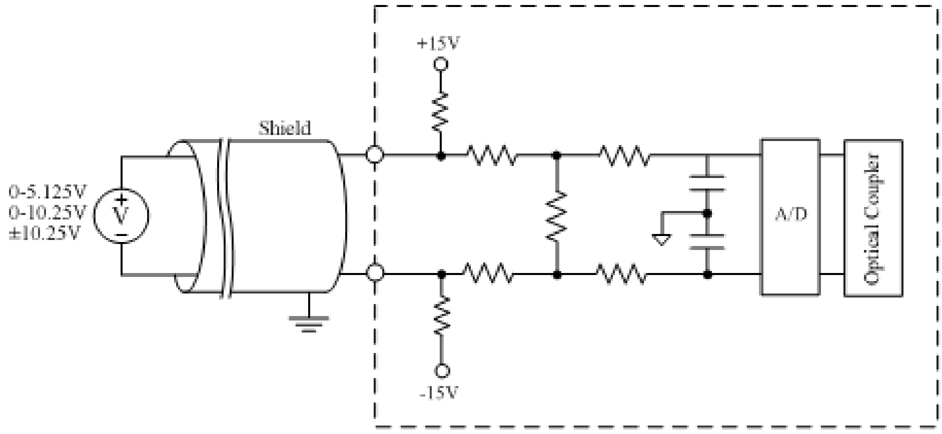


Figure 5.2: Input channel circuitry of the LK410 Module

5.2.3 Indicators Definition

Refer to section 5.1.1: The LED Status indicator

5.2.4 Wiring Specifications for LK410

LK410 module can be installed on both the LK local backplanes and the expansion backplanes.

Wiring to the Backplane Terminals

Input Channel No.	Terminal No.	
	Voltage Input +	Voltage Input -
1	01	02
2	03	04
3	05	06
4	07	08
5	09	10
6	11	12
7	13	14
8	15	16
NOT IN USE	17	18

Table 5.4: Wiring Terminal Definitions for LK410 and Backplane

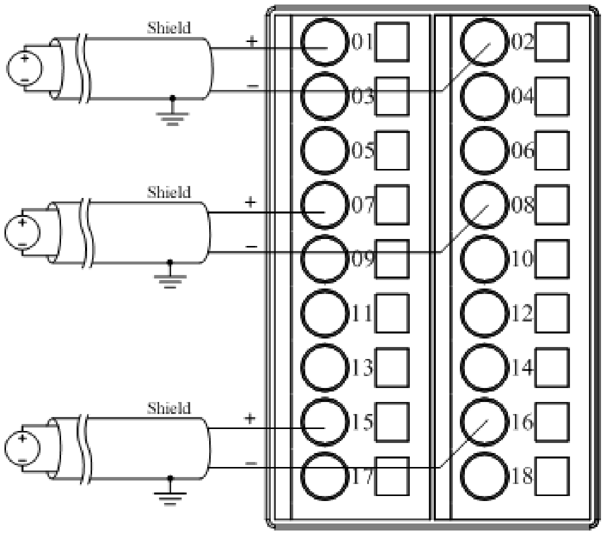


Figure 5.3: Backplane Terminal Wiring Diagram

Take note on the following during wiring:

- The 18 pins of wiring terminals, arranged in two columns, shall be installed and can be found on the backplane right under the installation slot of LK410 module.
- The odd-number terminals connect to the positive end of voltage signal while the even-number terminals connect to the negative end of the voltage signal.
- Each channel of the AI signals that come from the field is connected to its respective terminal with shielded cables.
- Terminal 17 and Terminal 18 shall not be used in wiring.

Wiring using Terminal Module

Please refer to the information found on Chapter 12: Terminal Module.

5.2.5 Data Signal and Conversion Specification

As shown in Figure 5.3, the measure data value that reported through LK410 module are represented by using a 2 byte positive integer codes (decimal value ranging from 0 to 65535). The measuring range for (-10.25 to +10.25V) are divided into two segments, positive and negative. Positive voltage signals (0 to 10.25V) are represented by decimal code value ranging from 0 to 32767 while negative voltage signals (-10.25 to 0V) by decimal code value ranging from 32768 to 65535.

Maximum Measuring Range		Machine Code Value (Decimal)
-10.25~+10.25V	0~10.25V	0~32767
	-10.25V~0V	32768~65535
0~10.25V		0~65535
0~5.125V		0~65535

Table 5.5: The Corresponding Relation of LK410 Input Voltage and its Decimal Code Value

For voltage signal range of -10.25 to +10.25,

The signal conversion equation is as follows:

- Positive voltage (0 to +10.25V) calculation:

Machine Code Value = Measured Positive Voltage x 32767 / 10.25

- Negative voltage (-10.25 to 0V) calculation:

Machine Code Value = 65535 + (Measure Negative Voltage x 32767 / 10.25)

PowerPro Programming tips:

- The function block **HS_HEX_ENGIN** in the analog conversion library **HS_AnalogConvert.lib** can be called to convert the 2byte measurement value into usable engineering data. The field signals that is being measured includes pressure, temperature, and voltage etc. After user define the upper and lower limit of engineer units, the function block will output the corresponding value according to the measurement value automatically.
- *For detailed usage of this function block, please refer to the LK Series PLC - Instruction Reference Manual.*

PowerPro Configuration Example

- For example, to set the upper and lower alarm limits of user parameters, the voltage signal shall be converted into the format of decimal machine codes. For different measurement ranges, the conversion methods are different.
- Taking channel 3 as an example, if its measurement range **"CH3 Input Range"** is set as "-10.25~+10.25V", the **upper and lower limit exceeding alarm** is enabled and the user-defined upper and lower limits value required are 10V and -10V respectively, then the **"CH3 Upper Limit Value"** equals to 10×32767/10.25=**31968** and the **"CH3 Lower Limit Value"** equals to 65535+(-10×32767/10.25)=**33567**.
- The user configuration parameters for PowerPro software is shown in Figure 5.4.

"CH3 Input Range"	-10.25~10.25V
"CH3 Upper Limit Exceeded Alarm"	Enable
"CH3 Lower Limit Exceeded Alarm"	Enable
"CH3 Upper Limit Value"	31968
"CH3 Lower Limit Value"	33567

Figure 5.4: Example of programming to set a range limit parameter

For the ranges of 0 to 10.25V and 0 to 5.125V,

The signal conversion equation is as follows:

Machine Code Value = (Measured Voltage Value × 65535) / Full Range Value

where the 'Full Range Value' = ' maximum measurable range value' – ' minimum measurable range value'

PowerPro Configuration Example

- Taking Channel 1 as an example, if its measurement range **"CH1 Input Range"** is set as "0~10.25V", and the upper and lower limit exceeded alarm is enabled. The user-defined upper and lower voltage limits value required are 10V and 5V respectively, then the "**Upper Limit Exceeded Alarm**" value equals to 10×65535/10.25=**63936** and the "**Lower Limit Exceeded Alarm**" value equals to 5×65535/10.25=**31968**.
- The user configuration parameter of PowerPro software is shown in Figure 5.5.

"CH1 Input Range"	0~10.25V
"CH1 Upper Limit Exceeded Alarm"	Enable
"CH1 Lower Limit Exceeded Alarm"	Enable
"CH1 Upper Limit Value"	63936
"CH1 Lower Limit Value"	31968

Figure 5.5: Example of programming to set a range limit parameter

5.2.6 Diagnostic and Alarm Features

PowerPro Configuration

PowerPro V4 configuration software uses an external diagnostic library to check and acquire various kinds of diagnosis information, such as whether the module parameters are setup correctly and whether the modules and its channels are operating normally. For the DP-slave station modules, the DP slave station expansion diagnosis function block (HS_DPSlaveALarm) shall be called to check the DP module at any address on the PROFIBUS-DP link, as shown in Figure 5.6.

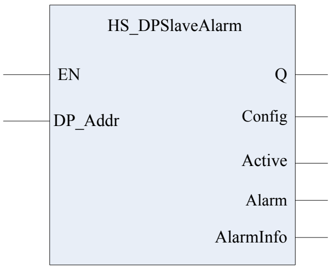


Figure 5.6: Expansion Diagnosis Function Block for DP Slave Station

For more detailed usage on DP Expansion Diagnosis Function Block, please refer to LK Series PLC - Instruction Reference Manual. Please take note that the diagnosis library is an external library and it should be installed first in the Library Manager before usage.

The diagnostic information of DP-slave station modules can be classified to three different categories. All diagnosis data exist in the form of a structure block.

- **Device Diagnostic**: records of the overall diagnosis information of the module, such as the power-loss at the field power supply.
- **Identifier Diagnostic**: records of whether the module has diagnosis information.
- **Channel Diagnostic**: records of the channel level diagnosis information, such as open-wired and range exceeding.

Diagnostic Information

This information includes channel status for function such as channel failure, over-limits, over-range, open-wired, etc. Device diagnoses such the field power supply failure checking can be applied on the power supply channel. After the DP slave station expansion diagnosis function block (HS_DPSlaveAlarm) is called, the channel diagnostic and device diagnostic data reported by LK410 will be stored in the corresponding fields of the output parameter "**AlarmInfo**", as shown in Table 5.6.

Diagnostic Alarm Information		Diagnostic Report Byte	Definition
Channel Diagnosis	ChDiag.Module.Channel.ChNo	1~8	Channel Number that the failure occurs
	ChDiag.Module.Channel.Error	0x02	Exceed Bottom Range
		0x03	Exceed Top Range
		0x06	Open-wired
		0x07	Exceed Upper Limit
		0x08	Exceed Lower Limit
		0x00	Channel Fault recovered

Table 5.6: Definition of LK410 Diagnosis Information

Over-Range Alarm

LK410 supports over-range alarm. When the input signals exceed the preset measurement range, the Channel Diagnosis will report only once **"Over Range"**, when the signal fell back into range again, it will report only once **"Failure Recovered"**.

Special attention shall be taken that for LK410 module, the valid range is not the maximum measurement range. Therefore, the input signals may still be within the maximum range when they exceed the valid range.

When the input signal exceeds valid range but are still within the maximum measurement range, the channel will report the code value of the current signal as the measured data; when the signal is higher than the maximum measurable voltage, the code value of the maximum measurable voltage will be reported as the

measured data; when the signal is lower than the measurable voltage, the channel will report the code value of the minimum measurable voltage.

Measurement Range	Range Exceeding	
	Over Range	Short of Range
-10V~10V	>10V	<-10V
0~10V	>10V	< 0V
0~5V	>5V	0V

Table 5.7: LK410 Definition of Range Exceeding

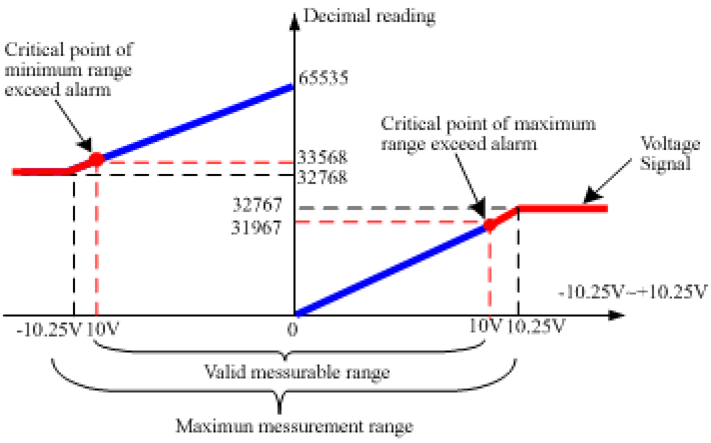


Figure 5.7: Range Exceeded Alarm of LK410

The module provides different diagnosis processes of rang exceeding for different ranges set by users, as shown in Table 5.8. When signals fall back into the normal range, the channel will report diagnosis byte 0x00.

Maximum Measurement Range	Valid Range	Exceeding Range	Process of Range Exceeding
-10.25V~10.25V	-10V~10V	Over Range	Channel report diagnosis byte 0x30 10~10.25V, Channel reports the code values 31967~32767 of the measured data >10.25V, channel reports 32767
		Short of Range	Channel report diagnosis byte 0x02 -10~10V, Channel reports the code values 32767~33568 of the measured data <-10.25V, channel reports 32768
0~10.25V	0~10V	Over Range	Channel report diagnosis byte 0x03 10~10.25V, channel reports the code values 63937~65535 of the measured data >10.25V, channel reports 65535
		Short of Range	Channel report diagnosis byte 0x02 channel reports 0
0~5.125V	0~5V	Over Range	Channel report diagnosis byte 0x03 5~5.125V, channel reports the code values 63937~65535 of the measured data >5.125V, channel reports 65535
		Short of Range	Channel report diagnosis byte 0x02 channel reports 0

Table 5.8: LK410 Processes of Range Exceeded Alarm in Different Ranges

Limits Exceeded Alarm

LK410 module provides the function of Limits Exceeded Alarm. Users can configure the upper and lower alarm limits of input signals. When input signals exceed the configured range, e.g. when they are higher than the upper alarm limit or lower than the lower limit, the channel will report diagnosis byte “exceed limits”. When input signals fall back into the configured range, the channel will report “failure recovered”.

LK410 module will only report the diagnosis data once respectively when signal exceeds limits and when the failure is recovered. As shown in Table 5.9, the upper alarm limit voltage shall be higher than the lower limit, otherwise LK410 module will not be able to correctly report diagnosis information.

Measurement Range	Alarm Signal
-10V~10V	10V > Upper Limit Voltage > Lower Limit Voltage > -10V
0~10V	10V > Upper Limit Voltage > Lower Limit Voltage > 0V
0~5V	5V > Upper Limit Voltage > Lower Limit Voltage > 0V

Table 5.9: Value Range of LK410 Alarm Limits

Represented by two bytes of positive integer codes, the alarm value in the configuration is the machine code value of those measured signal within the set Measurement Range. The value range of the upper alarm limit is 1~65535 and the default value is 32767. The value range of the lower alarm limit is 0~65534 and the default value is 0. Their calculation equations are as shown in Table 5.10.

Measurement Range		Upper Alarm Limit (Decimal)	Lower Alarm Limit (Decimal)
±10.25V	-10.25~0V	65535 + (Upper Limit Voltage × 32767/10.25)	65535 + (Lower Limit Voltage × 32767/10.25)
	0~10.25V	Upper Limit Voltage × 32767/10.25	Lower Limit Voltage × 32767/10.25
0~10.25V		Upper Limit Voltage × 65535/10.25	Lower Limit Voltage × 65535/10.25
0~5.125V		Upper Limit Voltage × 65535/5.125	Lower Limit Voltage × 65535/5.125

Table 5.10: Calculation of LK410 Alarm Value Codes

The lower limit exceeded alarm function is enabled by the configuration of parameter "CH1~CH8 Lower Limit Exceeded Alarm" while the upper limit exceeded alarm function is enabled by the configuration of parameter "CH1~CH8 Upper Limit Exceeded Alarm". The default configurations of both are "disabled". When the alarm functions are enabled, the lower and upper alarm limits can be set through parameters "CH1~CH8 Lower Limit value" and "CH1~CH8 Upper Limit Value".

The limit exceeded alarm function, upper and lower alarm limits of the 8 channels are configured separately. If the limit exceeded alarm is enabled, and the limit exceeding and range exceeding occur at the same time, LK410 will report the exceeding of range.

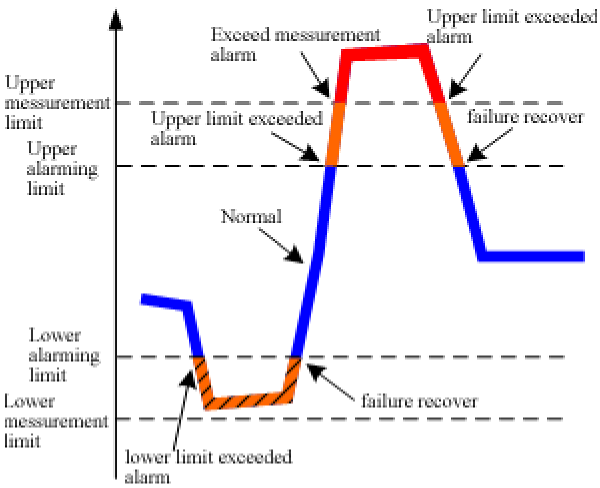


Figure 5.8: Limit Exceeded Alarm of LK410

In case the input signals of one channel exceed limit:

- When signals exceed the upper limit, the channel reports diagnosis byte 0x07
- When signals exceed the lower limit, the channel reports diagnosis byte 0x08
- The channel reports the code value of the currently measured signal.
- When signals fall back into the normal range, the channel reports diagnosis byte 0x00.

Detection of Line-break

LK410 module provides line-break detection function.

As shown in Figure 5.9, a 10MΩ pull-up resistor is connected to the signal channel. LK410 detects line-break by checking changes of the input voltage between two wiring terminals. In case of any failure, the failure status will be reported to the controller as the diagnosis data.

When there is line-break in an input channel, the positive-end voltage of the channel will be pulled up to +15V and the negative-end voltage will be pulled down to -15V, then the voltage difference on the input-end of AD transfer will reach the maximum value, the channel will report "Line-break". After the channel is reconnected, it will report "Failure Recovered".

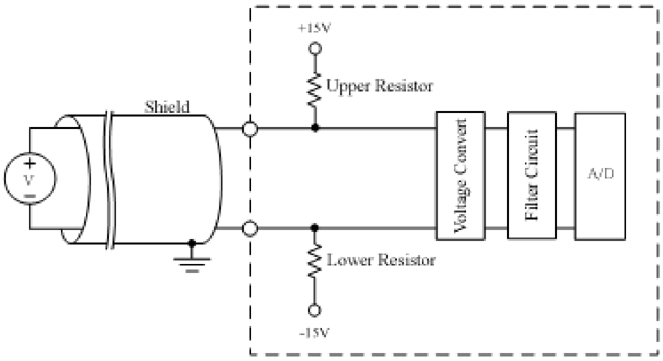


Figure 5.9: Principle of LK410 Line-break Detection

LK410 module will only report the diagnosis data once respectively when line-break occurs and when the failure is recovered. The alarm of line-break can be enabled through configuration software, the default setting of which is "disabled". If a input channel is not wired, it will be considered as disconnected. Therefore, for the channels not in use, it is suggested to disable the Line-break Alarm function, e.g. to keep the default value of parameter "Line Break Alarm".

When there is line-break of a channel:

- ➢ The channel will report diagnosis byte of line-break value 0x06
- ➢ The channel will report 65535 or 32768 (-10.25~10.25V Range) as the measurement data
- ➢ When the connection is recovered, the channel will report diagnosis byte 0x00

5.2.7 Parameter Specifications

The controller can only read and write the high-speed I/O information regularly after it entered data exchange mode. Therefore, in order to provide correct parameter information in the initialization process, users shall first set the parameters in the configuration software.

Communication Parameters

Supporting PROFIBUS-DP slave station protocol, LK410 completes data exchanges and diagnosis information reporting with the controller and other DP master stations. The slave station adopts a unique communication address, which is determined by the backplane number and the slot number of the LK410 module.

To establish the communication with the controller, the correct communication address of the slave station shall be filled in the LK410 module DP parameter field in the configuration software. Other communication parameters shall keep their default values.

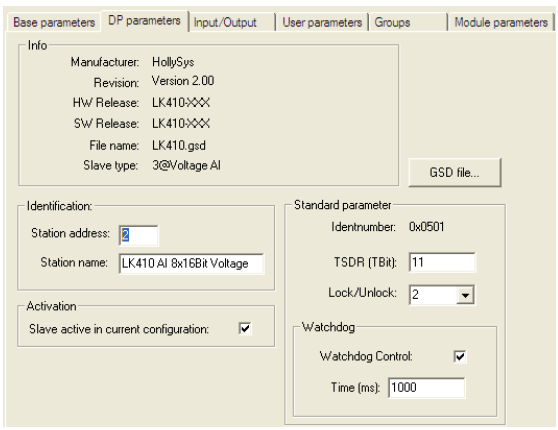


Figure 5.10: Setting of LK410 Communication Parameters

User Parameters

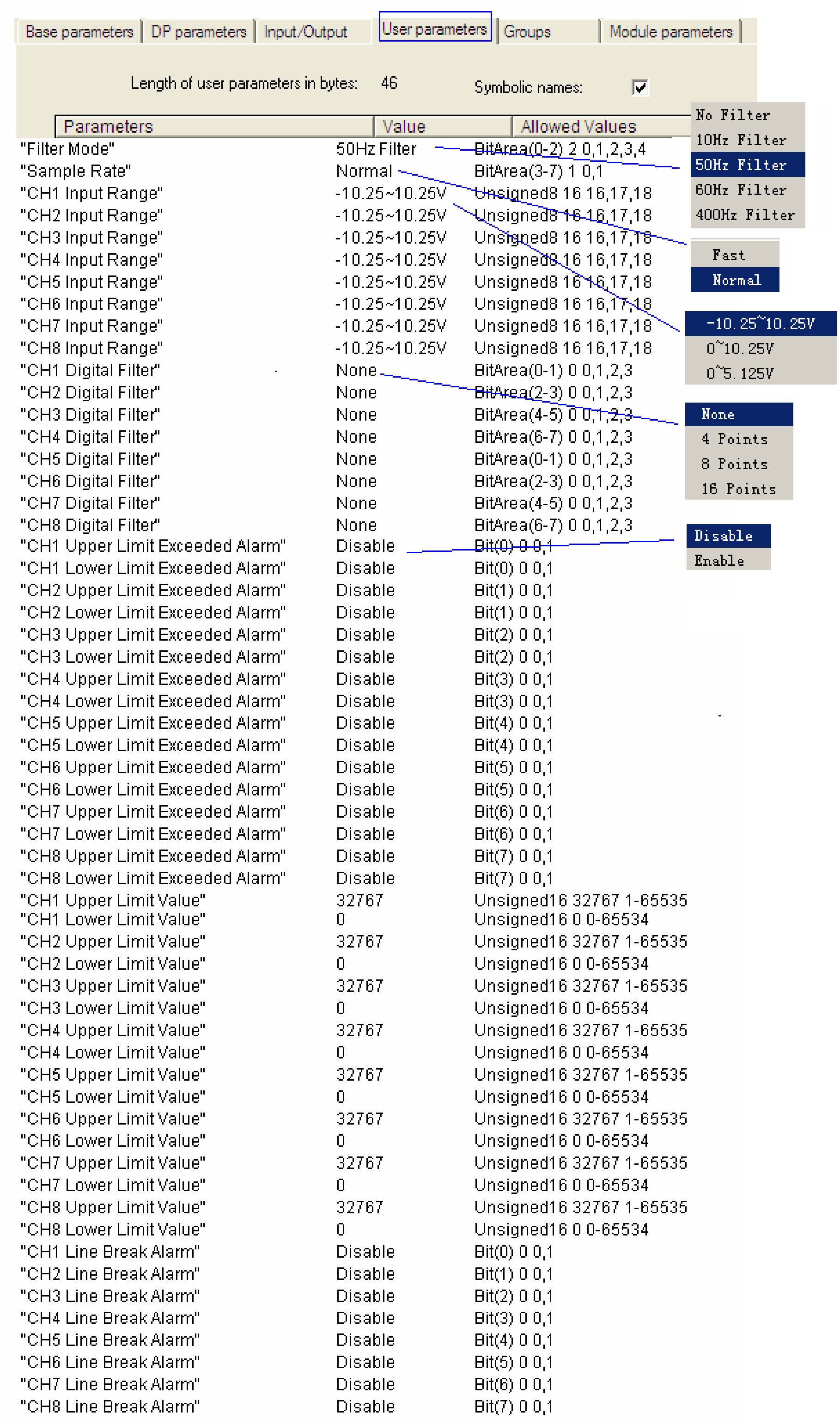
User parameters are used to configure the module's operating mode. They are written into the controller during the download of user program and will not be read in every scanning circle. Each parameter has a default value that can be changed according to requirements of the project. User parameters do not support online modification; therefore they can only be effective after the full download.

LK410 module has totally 46 bytes of user parameters.

Parameter Name	Parameter Definition	Parameter Value
Filter Mode	Parameter of Digital Filter Mode Selection	0=No Filter, no filter operation 1=10Hz Filter, filter of 10Hz interference 2=50Hz Filter, filter of 50Hz interference (default value) 3=60Hz Filter, filter of 60Hz interference 4=400Hz Filter, filter of 400Hz interference
Sample Rate	Sample Rate Selection	0: Fast, select the fastest sample rate; 1: Normal (Default value, drift control function enabled, but the internal sample time doubled)
CH1 Input Range	Range Selection of Channel 1	16=-10.25~10.25V Range (default value) 17=0~10.25V Range 18=0~5.125V Range
CH2 Input Range	Range Selection of Channel 2	
CH3 Input Range	Range Selection of Channel 3	
CH4 Input Range	Range Selection of Channel 4	
CH5 Input Range	Range Selection of Channel 5	
CH6 Input Range	Range Selection of Channel 6	
CH7 Input Range	Range Selection of Channel 7	
CH8 Input Range	Range Selection of Channel 8	
CH1 Digital Filter	Software Filter Selection of Channel 1	0=None, no software filter (default value) 1=4Points, select 4 latest history points 2=8Points, select 8 latest history points 3=16Points, select 16 latest history points
CH2 Digital Filter	Software Filter Selection of Channel 2	
CH3 Digital Filter	Software Filter Selection of Channel 3	
CH4 Digital Filter	Software Filter Selection of Channel 4	
CH5 Digital Filter	Software Filter Selection of Channel 5	
CH6 Digital Filter	Software Filter Selection of Channel 6	
CH7 Digital Filter	Software Filter Selection of Channel 7	
CH8 Digital Filter	Software Filter Selection of Channel 8	
CH1 Upper Limit Exceeded Alarm	Enable the Upper Limit Exceeded Alarm of Channel 1	0: Disable, the alarm is disabled (default); 1: Enable, the alarm is enabled.
CH1 Lower Limit Exceeded Alarm	Enable the Lower Limit Exceeded Alarm of Channel 1	
CH2 Upper Limit Exceeded Alarm	Enable the Upper Limit Exceeded Alarm of Channel 2	
CH2 Lower Limit Exceeded Alarm	Enable the Lower Limit Exceeded Alarm of Channel 2	
CH3 Upper Limit Exceeded Alarm	Enable the Upper Limit Exceeded Alarm of Channel 3	
CH3 Lower Limit Exceeded Alarm	Enable the Lower Limit Exceeded Alarm of Channel 3	
CH4 Upper Limit Exceeded Alarm	Enable the Upper Limit Exceeded Alarm of Channel 4	
CH4 Lower Limit Exceeded Alarm	Enable the Lower Limit Exceeded Alarm of Channel 4	
CH5 Upper Limit Exceeded Alarm	Enable the Upper Limit Exceeded Alarm of Channel 5	
CH5 Lower Limit Exceeded Alarm	Enable the Lower Limit Exceeded Alarm of Channel 5	
CH6 Upper Limit Exceeded Alarm	Enable the Upper Limit Exceeded Alarm of Channel 6	
CH6 Lower Limit Exceeded Alarm	Enable the Lower Limit Exceeded Alarm of Channel 6	
CH7 Upper Limit Exceeded Alarm	Enable the Upper Limit Exceeded Alarm of Channel 7	
CH7 Lower Limit Exceeded Alarm	Enable the Lower Limit Exceeded Alarm of Channel 7	
CH8 Upper Limit Exceeded Alarm	Enable the Upper Limit Exceeded Alarm of Channel 8	
CH8 Lower Limit Exceeded Alarm	Enable the Lower Limit Exceeded Alarm of Channel 9	
CH1 Upper Limit Value	Setting the Alarm Upper Limit Value of Channel 1	Alarm Lower Limit Range: 0~65534 Alarm Upper Limit Range: 1~65535 Alarm Lower Limit: 0 Alarm Upper Limit: 32767
CH1 Lower Limit Value	Setting the Alarm Lower Limit Value of Channel 1	
CH2 Upper Limit Value	Setting the Alarm Upper Limit Value of Channel 2	
CH2 Lower Limit Value	Setting the Alarm Lower Limit Value of Channel 2	

CH3Upper Limit Value	Setting the Alarm Upper Limit Value of Channel 3	
CH3 Lower Limit Value	Setting the Alarm Lower Limit Value of Channel 3	
CH4 Upper Limit Value	Setting the Alarm Upper Limit Value of Channel 4	
CH4 Lower Limit Value	Setting the Alarm Lower Limit Value of Channel 4	
CH5 Upper Limit Value	Setting the Alarm Upper Limit Value of Channel 5	
CH5 Lower Limit Value	Setting the Alarm Lower Limit Value of Channel 5	
CH6 Upper Limit Value	Setting the Alarm Upper Limit Value of Channel 6	
CH6 Lower Limit Value	Setting the Alarm Lower Limit Value of Channel 6	
CH7 Upper Limit Value	Setting the Alarm Upper Limit Value of Channel 7	
CH7 Lower Limit Value	Setting the Alarm Lower Limit Value of Channel 7	
CH8 Upper Limit Value	Setting the Alarm Upper Limit Value of Channel 8	
CH8 Lower Limit Value	Setting the Alarm Lower Limit Value of Channel 8	
CH1 Line Break Alarm	Enabled the Line-break Alarm of Channel 1	0: Disable, the alarm is disabled (default); 1: Enable, the alarm is enabled.
CH2 Line Break Alarm	Enabled the Line-break Alarm of Channel 2	
CH3 Line Break Alarm	Enabled the Line-break Alarm of Channel 3	
CH4 Line Break Alarm	Enabled the Line-break Alarm of Channel 4	
CH5 Line Break Alarm	Enabled the Line-break Alarm of Channel 5	
CH6 Line Break Alarm	Enabled the Line-break Alarm of Channel 6	
CH7 Line Break Alarm	Enabled the Line-break Alarm of Channel 7	
CH8 Line Break Alarm	Enabled the Line-break Alarm of Channel 8	

Table 5.11: List of LK410 User Parameters



Parameters	Value	Allowed Values
"Filter Mode"	50Hz Filter	BitArea(0-2) 2 0,1,2,3,4
"Sample Rate"	Normal	BitArea(3-7) 1 0,1
"CH1 Input Range"	-10.25~10.25V	Unsigned8 16 16,17,18
"CH2 Input Range"	-10.25~10.25V	Unsigned8 16 16,17,18
"CH3 Input Range"	-10.25~10.25V	Unsigned8 16 16,17,18
"CH4 Input Range"	-10.25~10.25V	Unsigned8 16 16,17,18
"CH5 Input Range"	-10.25~10.25V	Unsigned8 16 16,17,18
"CH6 Input Range"	-10.25~10.25V	Unsigned8 16 16,17,18
"CH7 Input Range"	-10.25~10.25V	Unsigned8 16 16,17,18
"CH8 Input Range"	-10.25~10.25V	Unsigned8 16 16,17,18
"CH1 Digital Filter"	None	BitArea(0-1) 0 0,1,2,3
"CH2 Digital Filter"	None	BitArea(2-3) 0 0,1,2,3
"CH3 Digital Filter"	None	BitArea(4-5) 0 0,1,2,3
"CH4 Digital Filter"	None	BitArea(6-7) 0 0,1,2,3
"CH5 Digital Filter"	None	BitArea(0-1) 0 0,1,2,3
"CH6 Digital Filter"	None	BitArea(2-3) 0 0,1,2,3
"CH7 Digital Filter"	None	BitArea(4-5) 0 0,1,2,3
"CH8 Digital Filter"	None	BitArea(6-7) 0 0,1,2,3
"CH1 Upper Limit Exceeded Alarm"	Disable	Bit(0) 0 0,1
"CH1 Lower Limit Exceeded Alarm"	Disable	Bit(0) 0 0,1
"CH2 Upper Limit Exceeded Alarm"	Disable	Bit(1) 0 0,1
"CH2 Lower Limit Exceeded Alarm"	Disable	Bit(1) 0 0,1
"CH3 Upper Limit Exceeded Alarm"	Disable	Bit(2) 0 0,1
"CH3 Lower Limit Exceeded Alarm"	Disable	Bit(2) 0 0,1
"CH4 Upper Limit Exceeded Alarm"	Disable	Bit(3) 0 0,1
"CH4 Lower Limit Exceeded Alarm"	Disable	Bit(3) 0 0,1
"CH5 Upper Limit Exceeded Alarm"	Disable	Bit(4) 0 0,1
"CH5 Lower Limit Exceeded Alarm"	Disable	Bit(4) 0 0,1
"CH6 Upper Limit Exceeded Alarm"	Disable	Bit(5) 0 0,1
"CH6 Lower Limit Exceeded Alarm"	Disable	Bit(5) 0 0,1
"CH7 Upper Limit Exceeded Alarm"	Disable	Bit(6) 0 0,1
"CH7 Lower Limit Exceeded Alarm"	Disable	Bit(6) 0 0,1
"CH8 Upper Limit Exceeded Alarm"	Disable	Bit(7) 0 0,1
"CH8 Lower Limit Exceeded Alarm"	Disable	Bit(7) 0 0,1
"CH1 Upper Limit Value"	32767	Unsigned16 32767 1-65535
"CH1 Lower Limit Value"	0	Unsigned16 0 0-65534
"CH2 Upper Limit Value"	32767	Unsigned16 32767 1-65535
"CH2 Lower Limit Value"	0	Unsigned16 0 0-65534
"CH3 Upper Limit Value"	32767	Unsigned16 32767 1-65535
"CH3 Lower Limit Value"	0	Unsigned16 0 0-65534
"CH4 Upper Limit Value"	32767	Unsigned16 32767 1-65535
"CH4 Lower Limit Value"	0	Unsigned16 0 0-65534
"CH5 Upper Limit Value"	32767	Unsigned16 32767 1-65535
"CH5 Lower Limit Value"	0	Unsigned16 0 0-65534
"CH6 Upper Limit Value"	32767	Unsigned16 32767 1-65535
"CH6 Lower Limit Value"	0	Unsigned16 0 0-65534
"CH7 Upper Limit Value"	32767	Unsigned16 32767 1-65535
"CH7 Lower Limit Value"	0	Unsigned16 0 0-65534
"CH8 Upper Limit Value"	32767	Unsigned16 32767 1-65535
"CH8 Lower Limit Value"	0	Unsigned16 0 0-65534
"CH1 Line Break Alarm"	Disable	Bit(0) 0 0,1
"CH2 Line Break Alarm"	Disable	Bit(1) 0 0,1
"CH3 Line Break Alarm"	Disable	Bit(2) 0 0,1
"CH4 Line Break Alarm"	Disable	Bit(3) 0 0,1
"CH5 Line Break Alarm"	Disable	Bit(4) 0 0,1
"CH6 Line Break Alarm"	Disable	Bit(5) 0 0,1
"CH7 Line Break Alarm"	Disable	Bit(6) 0 0,1
"CH8 Line Break Alarm"	Disable	Bit(7) 0 0,1

Figure 5.11: Setting of LK410 User Parameters

5.2.8 Module Installation and Un-installation

Refer to chapter 1 on "Module Insertion Mechanical keys" and "Module Insertion and Removable" for more details.

5.2.9 Technical Specification

LK410 8-Channel Voltage AI Module				
System Power Supply				
Power Supply Voltage	24VDC(-15%~+20%)			
Power Consumption	100mA@24VDC			
Input Channel				
Channel Number	8			
Range Code	16		17	18
Maximum Measurement Range	-10.25~0V	0~10.25V	0~10.25V	0~5.125V
Data Format	32768~65535	0~32767	0~65535	0~65535
ADC resolution	16digit			
Sampling Period (without software filtering)				
Hardware Filtering of 50Hz Interference	<480ms/8channel			
Hardware Filtering of 60Hz Interference	<480ms/8channel			
Input Impedance	>1MΩ			
Step Response Time	Less than 1 seconds to reach 90% of target value			
Differential Mode Suppression Rate	80dB			
Integral Mode Suppression Rate	100dB			
Measurement Precision	<0.1% F.S.@25ºC			
Calibration Precision	<0.03% F.S.@25ºC			
Calibration Period	12 months			
Temperature Drift	±25ppm/ºC			
Over-Voltage Protection	30VDC			
Isolation Voltage between Field and System	500VAC@1min, Current Leak 5mA			
Failure Diagnosis and Hot swap				
Limit Exceeded Alarm Measurement Range Exceeded Alarm Detection of Line-break	Signal range exceeded Alarm upper/lower limits, diagnosis byte reports 0x07/0x08 Signal exceeded range upper/lower limits, diagnosis byte reports 0x03/0x02 Connection lost, diagnosis byte reports 0x06, the channel reports 65535 or 32767 as the measurement data			
Hot swap	Support			
Communication Bus				
protocol	PROFIBUS-DP Slave Station, in accordance with IEC61158-3/EN50170 standards			
Baud Rate	Baud Rate Options: 1.5Mbps, 500Kbps, 187.5Kbps, 93.75Kbps, 45.45Kbps, 31.25Kbps, 19.2Kbps, 9.6Kbps			
Media	Communication bus is connected to the backplane through euro connector, hot redundant communication media			
Physical Features				
Mechanic Keys to Prevent Incorrect Insertion	A0			
Installation Location	LK local backplane or expansion backplane			
Dimension	Width × Height × Depth = 35mm×100mm×100mm			
Casing Protection Level	IEC60529 IP20			
Weight	190g			
Working Environment				
Working Temperature	0ºC~60ºC			
Working Relative Humidity	5%~95%, no condensate			
Storage Temperature	-40ºC~70ºC			
Storage relative Humidity	5%~95%, no condensate			

Table 5.12: Technical Specification of LK410 Module

5.3 LK411 [8-CHANNEL CURRENT AI MODULE]

5.3.1 Features

- 8-channel current input
- Measurement Range: 0~20mA/4~20mA
- Maximum Range: 0~20.58mA
- Support ProfiBus-DP slave station protocol
- Calibration on Field
- Limit Exceeded Alarm
- Measurement Range Exceeded Alarm
- Detection of Line-break
- System-to-Field Isolation
- Supports hot swap

5.3.2 Operation Principles

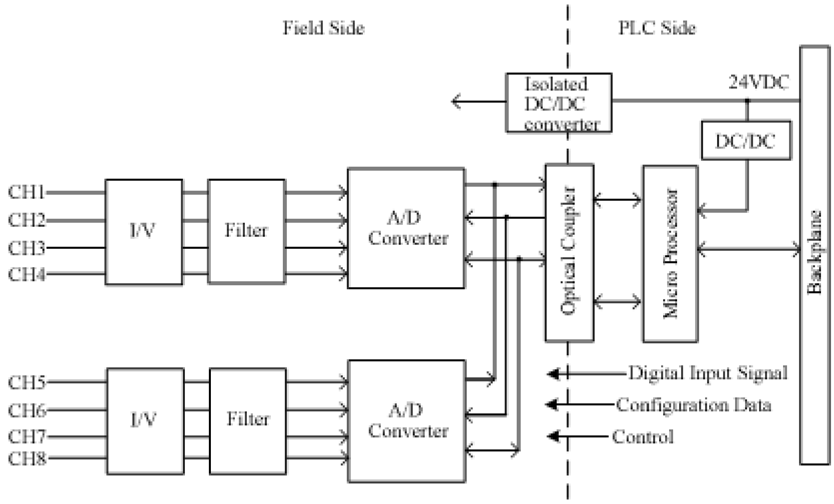


Figure 5.12: Internal Structure of LK411 Module

The 24V DC system power supply of LK 411 module goes through the isolated DC/DC converter to output a 5VDC power supply for the field input circuit. This input circuit is connected to other circuits through optical couplers to enable the isolation between the field circuit and the system.

As shown in Figure 5.13, the channel circuit input the current signals through current/voltage conversion, filter and A/D conversion to convert them into digital signals. After the photoelectric isolation, the module microprocessor read the signals and uploads them to the controller through DP bus.

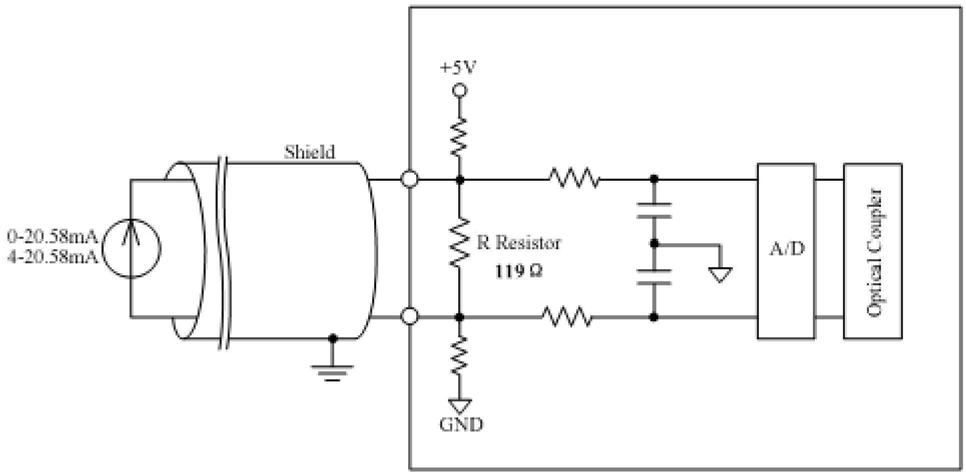


Figure 5.13: LK411 Channel Interface Circuit

5.3.3 I Indicators Definition

Refer to section 5.1.1: The LED Status indicator

5.3.4 Wiring Specifications

The input channels of LK411 do not provide power to external devices. Therefore, when it is connected with two-wire transformer, a separated 24V DC field power supply shall be adopted to provide power to the transformer. To ensure the isolation between field and system, the field power supply shall be separated from the backplane power supply.

LK411 module can be installed on both the LK local backplanes and the expansion backplanes. The LK series backplanes support two types of wirings: terminal wiring and prefabricated cable wiring.

Wiring to Backplane Terminals

Channel Number	Terminal Number	
	Current Input Terminal	Current Output Terminal
1	01	02
2	03	04
3	05	06
4	07	08
5	09	10
6	11	12
7	13	14
8	15	16

Table 5.13: Backplane Wiring Terminals Defination for LK411

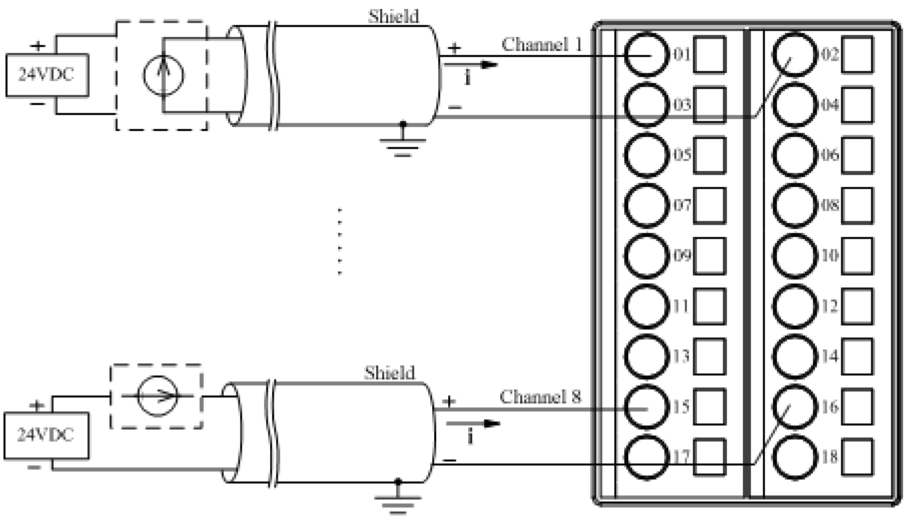


Table 5.14: Wiring for Backplane Terminal for LK411

In the wiring, the following shall be noted:

- The 18digit double wiring terminals shall be installed on the backplane, right under the installation slot of LK411 module.
- Each channel of the AI signals that come from the field is connected to its respective terminal through two (shielded) cables.
- The input channels do not supply power to the transformer; therefore a separated field 24V DC power supply will be needed when the module is connected to a two-wire transformer.
- To ensure the isolation between field and system, the field power supply shall be separated from the system power supply on the backplane.
- Terminal 17 and Terminal 18 shall not be used in wiring.

Wiring to Terminal Modules

Please refer to the information found on Chapter 12: Terminal Module.

5.3.5 Function Specifications

Output Format of the Measurement Data

As shown in Table 5.15, the measurement data that reported through LK411 AI channels are represented by 2byte positive integer codes (decimal value range 0~65535).

Maximum Measurement Range	Decimal Code Value
4~20.58mA	0~65535
0~20.58mA	0~65535

Table 5.15: The Corresponding Relation of LK411 Input Current and the Machine Code Value

The function block HS_HEX_ENGIN in the analog conversion library HS_AnalogConvert.lib of the configuration software PowerPro V4 can be called to convert the 2 byte measurement value into engineering data. (Engineering data = field side signal that being measured include pressure, temperature and voltage etc. Once user defined, the upper and lower limit of engineer units, function block will output the corresponding value according to the measurement value automatically.)

For detailed usage of the function block, please refer to the LK Series PLC - Instruction Manual.

To set the upper and lower alarm limits of user parameters, the current signals shall be converted into the format of decimal machine codes.

- For the ranges of 4~20.58mA, the signal and code value conversion equation is as follow:

  Code Value = (Current Signal - 4) × 65535/16.58

Take Channel 1 for example, if its measurement range is set as “4~20.58mA”, the limit exceeded alarm is enabled and the user-defined upper and lower current limits are set as 15mA and 5mA, then the alarm upper limit shall be(15-4)×65535/16.58=43479 and the lower limit (5-4)×65535/16.58=3952. The user parameter configuration is shown in Figure 5.14.

"CH1 Input Range"	4~20.58mA
"CH1 Upper Limit Exceeded Alarm"	Enable
"CH1 Lower Limit Exceeded Alarm"	Enable
"CH1 Upper Limit Value"	43479
"CH1 Lower Limit Value"	3952

Figure 5.14: Example of Parameter Setting in Set Range under Programming Mode

- For the ranges of 0~20.58mA, the signal and code value conversion equation is as follow:

  Code Value = Current Signal × 65535/20.58

Take Channel 3 for example, if its measurement range is set as “0~20.58mA”, the limit exceeded alarm is enabled and the user-defined upper and lower current limits are set as 15mA and 4mA, then the alarm upper limit shall be 15×65535/20.58=47766 and the lower limit 4×65535/20.58=12737. The user parameter configuration is shown in Figure 5.15.

"CH3 Input Range"	0~20.58mA
"CH3 Upper Limit Exceeded Alarm"	Enable
"CH3 Lower Limit Exceeded Alarm"	Enable
"CH3 Upper Limit Value"	47766
"CH3 Lower Limit Value"	12737

Figure 5.15: Example of Parameter Setting in Set Range under Programming Mode

5.3.6 Specifications of Diagnosis

PowerPro V4 configuration software adopts external diagnosis library to check and acquire all kinds of diagnosis information, such as whether the module and its channels are operating normally and whether the module parameters are set correctly.

For the DP slave station modules, the DP slave station expansion diagnosis function block (HS_DPSlaveALarm) shall be called to check the DP module at any address (DP_Addr) on the PROFIBUS-DP link, as shown in Figure 5.16.

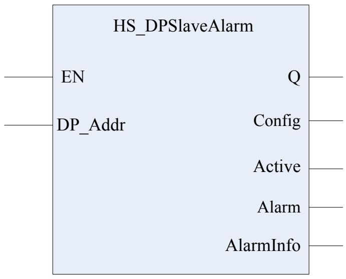


Figure 5.16: Expansion Diagnosis Function Block for DP Slave Station

For detailed usage of DP Expansion Diagnosis Function Block, please refer to LK Large Scale PLC Instruction Manual. Users shall note that the Diagnosis library is an external library that shall be first installed in the Library Manager before use.

The diagnosis information of DP slave station modules can be classified to 3 categories: device diagnosis, identifier diagnosis and channel diagnosis. All diagnosis data exist in the form of block structure.

- **Device Diagnosis:** records of the overall diagnosis information of the module, such as, power loss of field power supply.
- **Identifier Diagnosis:** records of whether the module has diagnosis information.
- **Channel Diagnosis:** records of the channel level diagnosis information, such as line-break and range exceeding.

Channel diagnoses such as those of range exceeding, limit exceeding and line-break may be applied to LK411 signal input channels. Device diagnoses such the field power supply failure checking can be applied on the power supply channel. After the DP slave station expansion diagnosis function block (HS_DPSlaveAlarm) is called, the channel diagnosis and device diagnosis data reported by LK411 will be stored in the corresponding fields of the output parameter "AlarmInfo", as shown in Table 5.16.

Diagnosis Information		Value	Definition
Channel Diagnosis	ChDiag.Module.Channel.ChNo	1~8	Channel Number of the Failure
	ChDiag.Module.Channel.Error	2	Short of Range
		3	Over Range
		6	Line-Break
		7	Upper Limit Exceeded
		8	Lower Limit Exceeded
		0	Channel Failure Recovered

Table 5.16: Diagnosis information definition for LK411

Measurement Range Exceeded Alarm

LK411 module provides the function of Measure Range Exceeded Alarm. When the input signals exceed the preset measurement range, Channel Diagnosis will report "Over Range", when the signal fell back into range again, it will report "Failure Recovered".

LK411 module will only report the diagnosis data once respectively when signals exceeded range and when the failure is recovered.

Special attention shall be taken that for LK411 module, the valid range is not the maximum measurement range. Therefore, the input signals may still be within the maximum range when they exceed the valid range.

When the input signal exceeds valid range but are still within the maximum measurement range, the channel will report the code value of the current signal; when the signal is higher than the maximum measurable current, the channel will report the full range code value 0xFFFF as the measured data; when the signal is lower than the minimum measurable current, the channel will report the code value 0x0000.

Measurement Range	Range Exceeding	
	Over Range	Short of Range
0~22mA	> 20mA	< 0mA
4~20mA	> 20mA	< 4mA

Table 5.17: Range exceeding definition for LK411

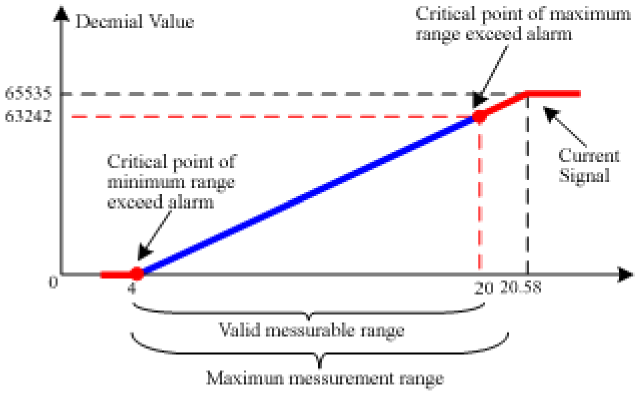


Figure 5.17: Range Exceeded Alarm for LK411

As for different ranges set by users, the module provides different diagnosis processes of range exceeding, as shown in Table 5.18. When signals fall back into the normal range, the channel will report diagnosis byte 0x00.

Maximum Measurement Range	Valid Range	Range Exceeding	Process of Range Exceeding Alarm
0~20.58mA	0~20mA	Over Range	Channel report diagnosis byte 0x03 20~20.58mA, the channel reports the code value (63688~65535) of the currently measured signal. >20.58mA, channel reports 65535
		Short of Range	Channel report diagnosis byte 0x02 Channel reports 0
4~20.58mA	4~20mA	Over Range	Channel report diagnosis byte 0x03 20~20.58mA, the channel reports the code value (63242~65535) of the currently measured signal. >20.58mA, channel reports 65535
		Short of Range	Channel report diagnosis byte 0x02 channel reports 0

Table 5.18: LK411 Processes of Range Exceeded Alarm in Different Ranges

Limit Exceeded Alarm

LK411 module provides the function of Limits Exceeding Alarm. Users can configure the upper and lower alarm limits of input signals within the set measurement range. When input signals exceed the configured range, e.g. when they are higher than the upper alarm limit or lower than the lower limit, the channel will report diagnosis byte “exceed limits”. When input signals fall back into the configured range, the channel will report “failure recovered”.

LK411 module will only report the diagnosis data once respectively when signal exceeds limits and when the failure is recovered. The limit exceeded alarm can be enabled through configuration software, the default setting of which is “disabled”. The alarm upper and lower limits of each channel can be defined by users. The upper alarm current limit shall be higher than the lower limit; otherwise LK411 module will not be able to correctly report diagnosis information.

If the limit exceeded alarm is enabled, and the limit exceeding and range exceeding occur at the same time, LK411 will report the exceeding of range.

Measurement Range	Alarm Signal
0~20mA	20mA > Current Upper Limit > Current Lower Limit > 0mA
4~20mA	20mA > Current Upper Limit > Current Lower Limit > 4mA

Table 5.19: Value Range of LK411 Alarm Limits

Represented by two bytes of positive integer codes (decimal 0~65535), the alarm value in the configuration is the machine code value of those measured signal within the set Measurement Range. The value range of the alarm upper limit is 1~65535 while its default value is 65535; the value range of the alarm lower limit is 0~65534 while its default value is 0.

Refer to the section on 5.3.5: Output Format of the Measurement Data for the detailed calculation.

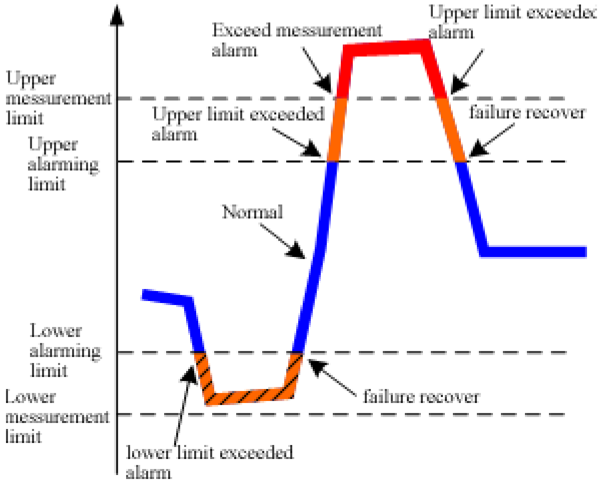


Figure 5.18: Limit Exceeded Alarm of LK411

In case the input signals of one channel exceed limit:

- When signals exceed the upper limit, the channel reports diagnosis byte 0x07
- When signals exceed the lower limit, the channel reports diagnosis byte 0x08
- The channel reports the code value of the currently measured signal.
- When signals fall back into the normal range, the channel reports diagnosis byte 0x00.

Detection of Line-break

LK411 module provides line-break detection function.

As shown in Figure 5.19, a 10MΩ pull-up resistor is connected to the signal channel. LK411 detects line-break by checking changes of the input voltage between two wiring terminals. In case of any failure, the failure status will be reported to the controller as the diagnosis data. When there is line-break in an input channel, the positive-end voltage of the channel will be pulled up to +5V and the negative-end voltage will be pulled down to GND, then the voltage difference on the input-end of AD transfer will reach the maximum value. The channel will report “Line-break”. After the channel is reconnected, it will report “Failure Recovered”.

LK411 module will only report the diagnosis data once respectively when line-break occurs and when the failure is recovered. If a input channel is not wired, it will be considered as disconnected. Therefore, for the channels not in use, it is suggested to disable the Line-break Alarm function, e.g. to keep the default value of parameter “Line Break Alarm”.

When there is line-break of a channel:

- The channel will report diagnosis byte of line-break value 0x06
- The channel reports code value 0x0000
- When the connection is recovered, the channel will report diagnosis byte 0x00

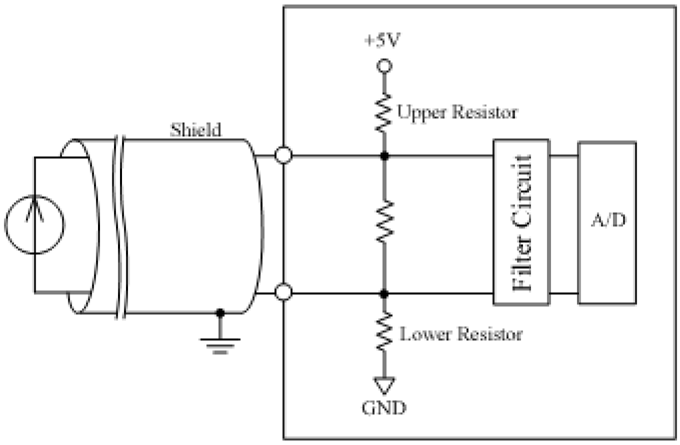


Figure 5.19: Principle of Line-break Detection for LK411

5.3.7 Parameter Specifications

The controller can only read and write the I/O information regularly after it entered data exchange mode. Therefore, in order to provide correct parameter information in the initialization process, users shall first set the parameters in the configuration software.

Communication Parameters

Supporting PROFIBUS-DP slave station protocol, LK411 completes data exchanges and diagnosis information reporting with the controller and other DP master stations. The slave station adopts a unique communication address, which is determined by the backplane number and the slot number of the LK411 module.

To establish the communication with the controller, the correct communication address of the slave station shall be filled in the LK411 module DP parameter field in the configuration software. Other communication parameters shall keep their default values.

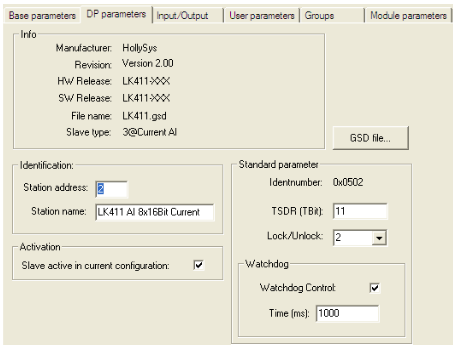


Figure 5.20: Setting of LK411 Communication Parameters

User Parameters

User parameters are used to configure the module's operating mode. They are written into the controller during the download of user program and will not be read in every scanning circle. Each parameter has a default value that can be changed according to requirements of the project. User parameters do not support online modification; therefore they can only be effective after the full download.

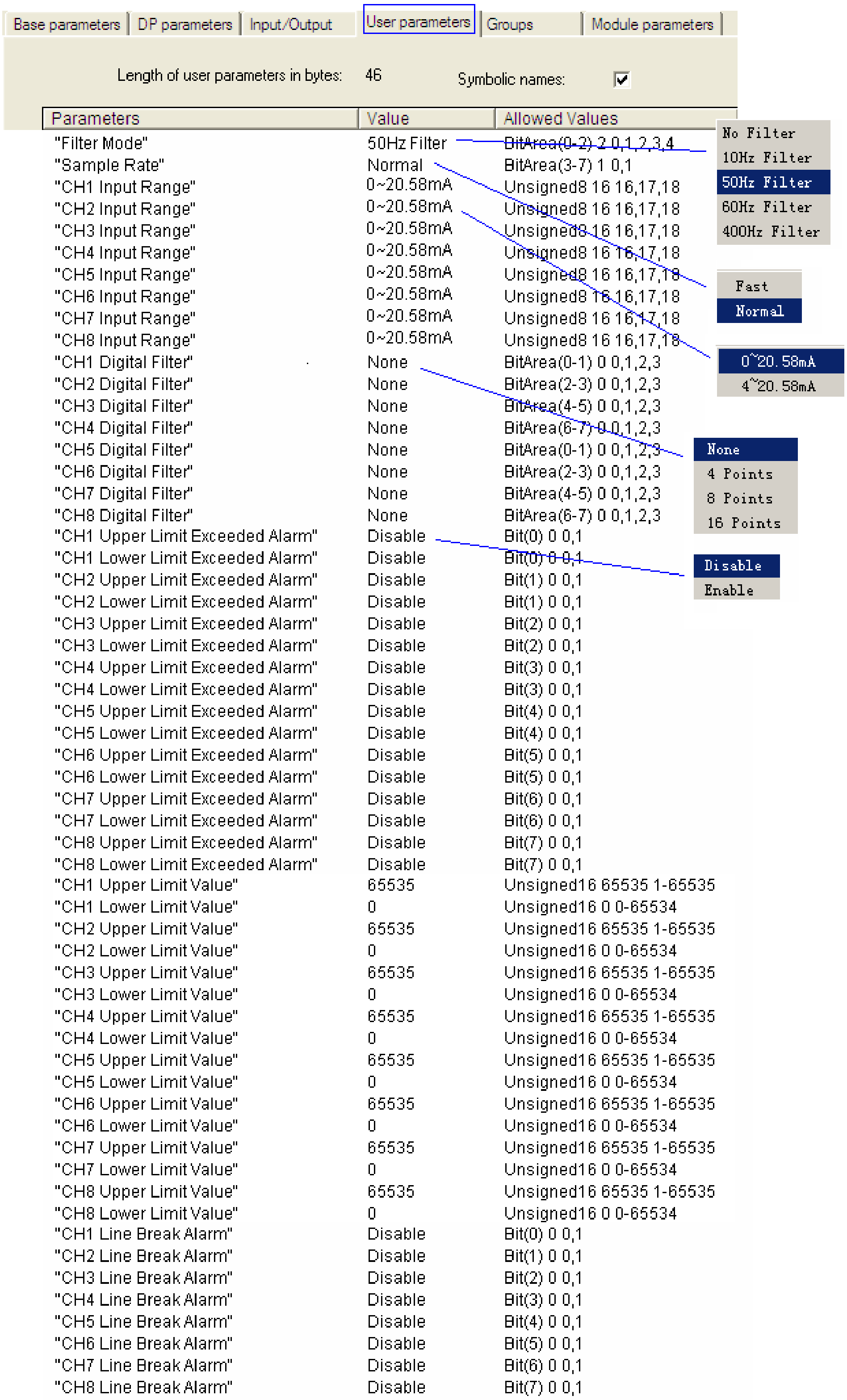
LK411 module has totally 46 bytes of user parameters.

Parameter Name	Parameter Definition	Value Options
	Parameter of Digital Filter Mode Selection	0=No Filter, no filter operation 1=10Hz Filter, filter of 10Hz interference 2=50Hz Filter, filter of 50Hz interference (default value) 3=60Hz Filter, filter of 60Hz interference 4=400Hz Filter, filter of 400Hz interference
	Sample Rate Selection	0: Fast, the fastest sample rate;

		1: Normal (Default value, drift control function enabled, but the internal sample time doubled)
CH1 Input Range	Range Selection of Channel 1	70=0~20.58mA (Default) 71=4~20.58mA
CH2 Input Range	Range Selection of Channel 2	
CH3 Input Range	Range Selection of Channel 3	
CH4 Input Range	Range Selection of Channel 4	
CH5 Input Range	Range Selection of Channel 5	
CH6 Input Range	Range Selection of Channel 6	
CH7 Input Range	Range Selection of Channel 7	
CH8 Input Range	Range Selection of Channel 8	
CH1 Digital Filter	Software Filter Selection of Channel 1	0=None, no software filter (default value) 1=4Points, select 4 latest history points 2=8Points, select 8 latest history points 3=16Points, select 16 latest history points
CH2 Digital Filter	Software Filter Selection of Channel 2	
CH3 Digital Filter	Software Filter Selection of Channel 3	
CH4 Digital Filter	Software Filter Selection of Channel 4	
CH5 Digital Filter	Software Filter Selection of Channel 5	
CH6 Digital Filter	Software Filter Selection of Channel 6	
CH7 Digital Filter	Software Filter Selection of Channel 7	
CH8 Digital Filter	Software Filter Selection of Channel 8	
CH1 Upper Limit Exceeded Alarm	Enable the Upper Limit Exceeded Alarm of Channel 1	0: Disable, the alarm is disabled (default); 1: Enable, the alarm is enabled.
CH1 Lower Limit Exceeded Alarm	Enable the Lower Limit Exceeded Alarm of Channel 1	
CH2 Upper Limit Exceeded Alarm	Enable the Upper Limit Exceeded Alarm of Channel 2	
CH2 Lower Limit Exceeded Alarm	Enable the Lower Limit Exceeded Alarm of Channel 2	
CH3 Upper Limit Exceeded Alarm	Enable the Upper Limit Exceeded Alarm of Channel 3	
CH3 Lower Limit Exceeded Alarm	Enable the Lower Limit Exceeded Alarm of Channel 3	
CH4 Upper Limit Exceeded Alarm	Enable the Upper Limit Exceeded Alarm of Channel 4	
CH4 Lower Limit Exceeded Alarm	Enable the Lower Limit Exceeded Alarm of Channel 4	
CH5 Upper Limit Exceeded Alarm	Enable the Upper Limit Exceeded Alarm of Channel 5	
CH5 Lower Limit Exceeded Alarm	Enable the Lower Limit Exceeded Alarm of Channel 5	
CH6 Upper Limit Exceeded Alarm	Enable the Upper Limit Exceeded Alarm of Channel 6	
CH6 Lower Limit Exceeded Alarm	Enable the Lower Limit Exceeded Alarm of Channel 6	
CH7 Upper Limit Exceeded Alarm	Enable the Upper Limit Exceeded Alarm of Channel 7	
CH7 Lower Limit Exceeded Alarm	Enable the Lower Limit Exceeded Alarm of Channel 7	
CH8 Upper Limit Exceeded Alarm	Enable the Upper Limit Exceeded Alarm of Channel 8	
CH8 Lower Limit Exceeded Alarm	Enable the Lower Limit Exceeded Alarm of Channel 9	
CH1 Upper Limit Value	Setting the Alarm Upper Limit Value of Channel 1	Alarm Lower Limit Range: 0~65534 Alarm Upper Limit Range: 1~65535 Alarm Default Lower Limit: 0 Alarm Default Upper Limit: 65535
CH1 Lower Limit Value	Setting the Alarm Lower Limit Value of Channel 1	
CH2 Upper Limit Value	Setting the Alarm Upper Limit Value of Channel 2	
CH2 Lower Limit Value	Setting the Alarm Lower Limit Value of Channel 2	
CH3Upper Limit Value	Setting the Alarm Upper Limit Value of Channel 3	
CH3 Lower Limit Value	Setting the Alarm Lower Limit Value of Channel 3	
CH4 Upper Limit Value	Setting the Alarm Upper Limit Value of Channel 4	
CH4 Lower Limit Value	Setting the Alarm Lower Limit Value of Channel 4	
CH5 Upper Limit Value	Setting the Alarm Upper Limit Value of Channel 5	
CH5 Lower Limit Value	Setting the Alarm Lower Limit Value of Channel 5	
CH6 Upper Limit Value	Setting the Alarm Upper Limit Value of Channel 6	
CH6 Lower Limit Value	Setting the Alarm Lower Limit Value of Channel 6	
CH7 Upper Limit Value	Setting the Alarm Upper Limit Value of Channel 7	
CH7 Lower Limit Value	Setting the Alarm Lower Limit Value of Channel 7	
CH8 Upper Limit Value	Setting the Alarm Upper Limit Value of Channel 8	
CH8 Lower Limit Value	Setting the Alarm Lower Limit Value of Channel 8	
CH1 Line Break Alarm	Enabled the Line-break Alarm of Channel 1	0: Disable, the alarm is disabled (default); 1: Enable, the alarm is enabled.
CH2 Line Break Alarm	Enabled the Line-break Alarm of Channel 2	
CH3 Line Break Alarm	Enabled the Line-break Alarm of Channel 3	
CH4 Line Break Alarm	Enabled the Line-break Alarm of Channel 4	
CH5 Line Break Alarm	Enabled the Line-break Alarm of Channel 5	

CH6 Line Break Alarm	Enabled the Line-break Alarm of Channel 6	
CH7 Line Break Alarm	Enabled the Line-break Alarm of Channel 7	
CH8 Line Break Alarm	Enabled the Line-break Alarm of Channel 8	

Table 5.20: List of LK411 User Parameters



Parameters	Value	Allowed Values
"Filter Mode"	50Hz Filter	BitArea(0-2) 2 0,1,2,3,4
"Sample Rate"	Normal	BitArea(3-7) 1 0,1
"CH1 Input Range"	0~20.58mA	Unsigned8 16 16,17,18
"CH2 Input Range"	0~20.58mA	Unsigned8 16 16,17,18
"CH3 Input Range"	0~20.58mA	Unsigned8 16 16,17,18
"CH4 Input Range"	0~20.58mA	Unsigned8 16 16,17,18
"CH5 Input Range"	0~20.58mA	Unsigned8 16 16,17,18
"CH6 Input Range"	0~20.58mA	Unsigned8 16 16,17,18
"CH7 Input Range"	0~20.58mA	Unsigned8 16 16,17,18
"CH8 Input Range"	0~20.58mA	Unsigned8 16 16,17,18
"CH1 Digital Filter"	None	BitArea(0-1) 0 0,1,2,3
"CH2 Digital Filter"	None	BitArea(2-3) 0 0,1,2,3
"CH3 Digital Filter"	None	BitArea(4-5) 0 0,1,2,3
"CH4 Digital Filter"	None	BitArea(6-7) 0 0,1,2,3
"CH5 Digital Filter"	None	BitArea(0-1) 0 0,1,2,3
"CH6 Digital Filter"	None	BitArea(2-3) 0 0,1,2,3
"CH7 Digital Filter"	None	BitArea(4-5) 0 0,1,2,3
"CH8 Digital Filter"	None	BitArea(6-7) 0 0,1,2,3
"CH1 Upper Limit Exceeded Alarm"	Disable	Bit(0) 0 0,1
"CH1 Lower Limit Exceeded Alarm"	Disable	Bit(0) 0 0,1
"CH2 Upper Limit Exceeded Alarm"	Disable	Bit(1) 0 0,1
"CH2 Lower Limit Exceeded Alarm"	Disable	Bit(1) 0 0,1
"CH3 Upper Limit Exceeded Alarm"	Disable	Bit(2) 0 0,1
"CH3 Lower Limit Exceeded Alarm"	Disable	Bit(2) 0 0,1
"CH4 Upper Limit Exceeded Alarm"	Disable	Bit(3) 0 0,1
"CH4 Lower Limit Exceeded Alarm"	Disable	Bit(3) 0 0,1
"CH5 Upper Limit Exceeded Alarm"	Disable	Bit(4) 0 0,1
"CH5 Lower Limit Exceeded Alarm"	Disable	Bit(4) 0 0,1
"CH6 Upper Limit Exceeded Alarm"	Disable	Bit(5) 0 0,1
"CH6 Lower Limit Exceeded Alarm"	Disable	Bit(5) 0 0,1
"CH7 Upper Limit Exceeded Alarm"	Disable	Bit(6) 0 0,1
"CH7 Lower Limit Exceeded Alarm"	Disable	Bit(6) 0 0,1
"CH8 Upper Limit Exceeded Alarm"	Disable	Bit(7) 0 0,1
"CH8 Lower Limit Exceeded Alarm"	Disable	Bit(7) 0 0,1
"CH1 Upper Limit Value"	65535	Unsigned16 65535 1-65535
"CH1 Lower Limit Value"	0	Unsigned16 0 0-65534
"CH2 Upper Limit Value"	65535	Unsigned16 65535 1-65535
"CH2 Lower Limit Value"	0	Unsigned16 0 0-65534
"CH3 Upper Limit Value"	65535	Unsigned16 65535 1-65535
"CH3 Lower Limit Value"	0	Unsigned16 0 0-65534
"CH4 Upper Limit Value"	65535	Unsigned16 65535 1-65535
"CH4 Lower Limit Value"	0	Unsigned16 0 0-65534
"CH5 Upper Limit Value"	65535	Unsigned16 65535 1-65535
"CH5 Lower Limit Value"	0	Unsigned16 0 0-65534
"CH6 Upper Limit Value"	65535	Unsigned16 65535 1-65535
"CH6 Lower Limit Value"	0	Unsigned16 0 0-65534
"CH7 Upper Limit Value"	65535	Unsigned16 65535 1-65535
"CH7 Lower Limit Value"	0	Unsigned16 0 0-65534
"CH8 Upper Limit Value"	65535	Unsigned16 65535 1-65535
"CH8 Lower Limit Value"	0	Unsigned16 0 0-65534
"CH1 Line Break Alarm"	Disable	Bit(0) 0 0,1
"CH2 Line Break Alarm"	Disable	Bit(1) 0 0,1
"CH3 Line Break Alarm"	Disable	Bit(2) 0 0,1
"CH4 Line Break Alarm"	Disable	Bit(3) 0 0,1
"CH5 Line Break Alarm"	Disable	Bit(4) 0 0,1
"CH6 Line Break Alarm"	Disable	Bit(5) 0 0,1
"CH7 Line Break Alarm"	Disable	Bit(6) 0 0,1
"CH8 Line Break Alarm"	Disable	Bit(7) 0 0,1

Figure 5.21: Setting of LK411 User Parameters

5.3.8 Module Installation and Un-installation

Refer to chapter 1 on "Module Insertion Mechanical keys" and "Module Insertion and Removable" for more details.

5.3.9 Technical Specification

LK411 8-Channel Current AI Module		
System Power Supply		
Power Supply Voltage	24VDC(-15%~+20%)	
Power Consumption	60mA@24VDC	
Input Channel		
Channel Number	8	
Range Code	70	71
Maximum Measurement Range	0~20.58mA	4~20.58mA
Data Format	0x0000~0xFFFF	0x0000~0xFFFF
ADC resolution	16digit	
Sampling Period (without software filtering)		
Hardware Filtering of 50Hz Interference	<480ms/8channel	
Hardware Filtering of 60Hz Interference	<480ms/8channel	
Input Impedance	243Ω	
Step Response Time	Less than 1 seconds to reach 90% of target value	
Differential Mode Suppression Rate	80dB	
Integral Mode Suppression Rate	100dB	
Measurement Precision	<0.1% F.S.@25ºC	
Calibration Precision	<0.03% F.S.@25ºC	
Calibration Period	12 months	
Temperature Drift	±25ppm/ºC	
Isolation Voltage between Field and System	500VAC@1min, Current Leak 5mA	
Failure Diagnosis and Hot swap		
Limit Exceeded Alarm Measurement Range Exceeded Alarm Detection of Line-break	Signal range exceeded Alarm upper/lower limits, diagnosis byte reports 0x07/0x08 Signal range exceeded Alarm upper/lower limits, diagnosis byte reports 0x03/0x02 Line-break, channel reports diagnosis byte 0x60. Connection recovered, channel reports 0x00	
Hot swap	Support	
Communication Bus		
protocol	PROFIBUS-DP Slave Station, in accordance with IEC61158-3/EN50170 standards	
Baud Rate	Baud Rate Options: 1.5Mbps, 500Kbps, 187.5Kbps, 93.75Kbps, 45.45Kbps, 31.25Kbps, 19.2Kbps, 9.6Kbps	
Media	Communication bus is connected to the backplane through euro connector, hot redundant communication media	
Physical Features		
Mechanic Keys to Prevent Incorrect Insertion	A1	
Installation Location	LK local backplane or expansion backplane	
Dimension	Width × Height × Depth = 35mm×100mm×100mm	
Casing Protection Level	IEC60529 IP20	
Weight	190g	
Working Environment		
Working Temperature	0ºC ~60ºC	
Working Relative Humidity	5%~95%, no condensate	
Storage Temperature	-40ºC ~70ºC	
Storage relative Humidity	5%~95%, no condensate	

Table 5.21: Technical Specification of LK411Module

5.4 LK414 [8-CHANNEL CURRENT EXTERNAL POWERED AI MODULE]

5.4.1 Features

- 8-channel two-wire transformer current input
- External powered, 25mA current limit protection
- Signal Input Range: 4~20.58mA
- Support ProfiBus-DP slave station protocol
- Calibration on Field
- Upper Limit Exceeded Alarm
- Lower Limit Exceeded Alarm
- Measurement Range Exceeded Alarm
- Detection of Line-break
- On Field Power Loss Detection
- System-to-Field Isolation
- Supports hot swap

5.4.2 Operation Principles

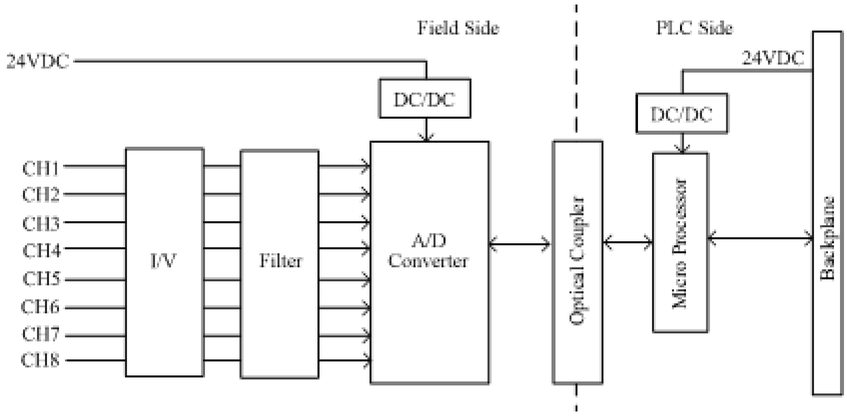


Figure 5.22: Internal Structure of LK414 Module

The 24V DC power supply of LK 414 module goes through the DC/DC converter to output a 5VDC power supply for the system while the field input circuit is supplied by a separated external 24V DC power supply. The circuits of these two parts are electrically isolated to enable the isolation between the field and the system

After I/V conversion, filter circuits and A/D conversion, the input analog current signals will be converted into digital signals. Then the digital signals are sent through photoelectric isolated circuit into micro-controller for processing and uploaded to the controller through DP bus.

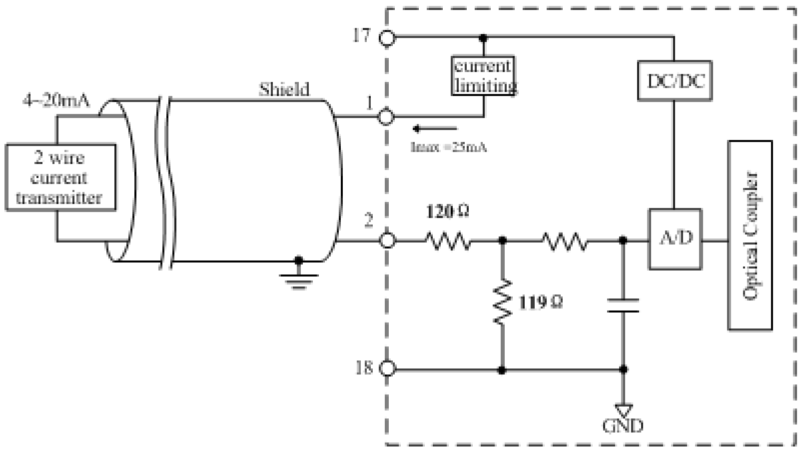


Figure 5.23: LK414 Channel Interface Circuit (Taking Channel1 as Example)

5.4.3 Indicators Definition

Refer to section 5.1.1: The LED Status indicator

5.4.4 Wiring Specifications

As an external powered current module, LK414 adopts two cables to connect the current signals of the field two-wire transformer to its signal input channels. The module introduces a field 24V DC power through the power input channels to supply its 8 AI channels. To ensure the isolation between field and system, the field power supply shall be separated from the backplane power supply.

LK414 module can be installed on either the LK local backplanes or the expansion backplanes. The LK series backplanes support two types of wirings: terminal wiring and prefabricated cable wiring.

Wiring to Backplane Terminals

Channel Number	Terminal Number	
	Current Output Terminal	Current Input Terminal
1	01	02
2	03	04
3	05	06
4	07	08
5	09	10
6	11	12
7	13	14
8	15	16
External Field Power Supply	24VDC	GND
	17	18

Table 5.22: Definitions of LK414 Backplane Wiring Terminals

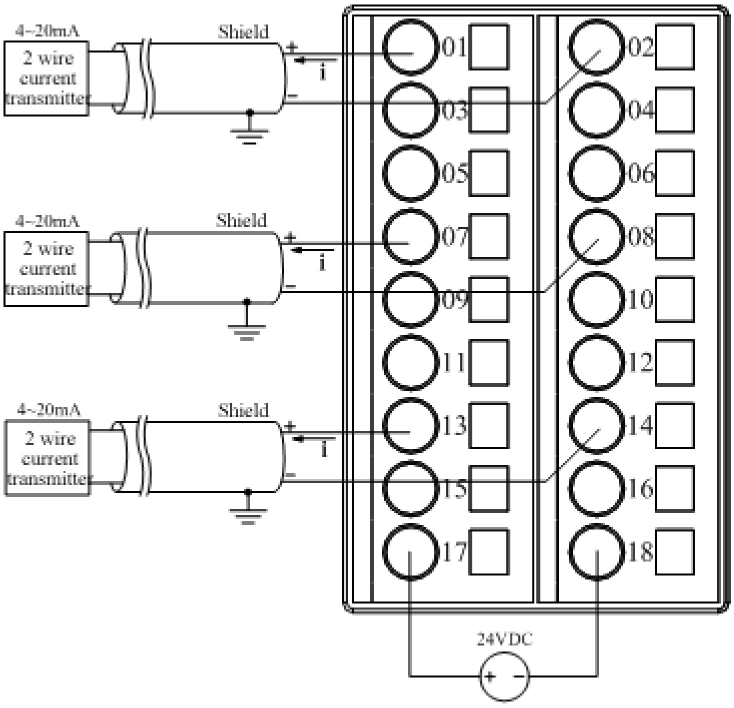


Figure 5.24: Wiring of LK414 Backplane Terminals

In the wiring, the following shall be noted:

- The 18digit double wiring terminals shall be installed on the backplane, right under the installation slot of LK414 module.
- Each channel of the AI signals that come from the field is connected to its respective terminal through two (shielded) cables.
- Supplied by external power, the module connects to field two-wire current devices.
- Terminal "17" and "18" connect to external 24V DC field power to supply input channels.
- To ensure the isolation between field and system, the system power supply on the backplane shall not be shared as the field power supply.

Wiring to Terminal Modules

Please refer to the information found on Chapter 12: Terminal Module.

5.4.5 Function Specifications

Output Format of the Measurement Data

As shown in Table 5.23, the measurement data that reported through LK414 AI channels are represented by 2byte positive integer codes (decimal value range 0~65535).

Maximum Measurement Range	Decimal Code Value
4~20.58mA	0~65535

Table 5.23: The Corresponding Relation of LK414 Input Current and the Machine Code Value

The function block HS_HEX_ENGIN in the analog conversion library HS_AnalogConvert.lib of the configuration software PowerPro V4 can be called to convert the 2byte measurement value into engineering data.(Field Side signal that being measured include pressure, temperature and voltage etc. Once users define, the upper and lower limit of engineer units, the function block will output the corresponding value according to the measured value automatically.)

For detailed usage of the function block, please refer to LK Series PLC - Instruction Manual.

To set the upper and lower alarm limits of user parameters, the current signals shall be converted into the format of decimal machine codes.

- For the ranges of 4~20.58mA, the signal and code value conversion equation is as follow:

  Code Value = (Current Signal - 4) × 65535/16.58

Take Channel 1 for example, if the limit exceeded alarm is enabled and the user-defined upper and lower current limits are set as 15mA and 5mA, then the alarm upper limit shall be(15-4)×65535/16.58=43479 and the lower limit (5-4)×65535/16.58=3952. The user parameter configuration is shown in Figure 5.25.

"CH1 Upper Limit Exceeded Alarm"	Enable
"CH1 Lower Limit Exceeded Alarm"	Enable
"CH1 Upper Limit Value"	43479
"CH1 Lower Limit Value"	3952

Figure 5.25: Example of Parameter Setting in Set Range under Programming Mode

5.4.6 Specifications of Diagnosis

PowerPro V4 configuration software adopts external diagnosis library to check and acquire all kinds of diagnosis information, such as whether the module and its channels are operating normally and whether the module parameters are set correctly.

For the DP slave station modules, the DP slave station expansion diagnosis function block (HS_DPSlaveALarm) shall be called to check the DP module at any address (DP_Addr) on the PROFIBUS-DP link, as shown in Figure 5.26.

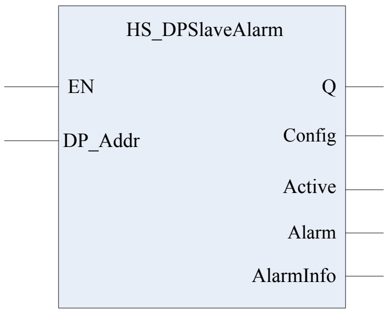


Figure 5.26: Expansion Diagnosis Function Block for DP Slave Station

For detailed usage of DP Expansion Diagnosis Function Block, please refer to LK Large Scale PLC Instruction Manual. Users shall note that the Diagnosis library is an external library that shall be first installed in the Library Manager before use.

The diagnosis information of DP slave station modules can be classified to 3 categories: device diagnosis, identifier diagnosis and channel diagnosis. All diagnosis data exist in the form of block structure.

- **Device Diagnosis:** records of the overall diagnosis information of the module, such as, power loss of field power supply.
- **Identifier Diagnosis:** records of whether the module has diagnosis information.
- **Channel Diagnosis:** records of the channel level diagnosis information, such as line-break and rang exceeding.

Channel diagnoses such as those of range exceeding, limit exceeding and line-break may be applied to LK414 signal input channels. Device diagnoses such the field power supply failure checking can be applied on the power supply channel. After the DP slave station expansion diagnosis function block (HS_DPSlaveAlarm) is called, the channel diagnosis and device diagnosis data reported by LK414 will be stored in the corresponding fields of the output parameter "AlarmInfo", as shown in Table 5.24.

Diagnosis Information		Value	Definition
Channel Diagnosis	ChDiag.Module.Channel.ChNo	1~8	Channel Number of the Failure
	ChDiag.Module.Channel.Error	2	Short of Range
		3	Over Range
		4	Overload
		6	Line-Break
		7	Upper Limit Exceeded
		8	Lower Limit Exceeded
		0	Channel Failure Recovered
Device Diagnosis	ALarmInfo.DevDiag.Data[1]	4	Power Loss of Field Power Supply
		0	Failure Recovered

Table 5.24: Definition of LK414 Diagnosis Information

Field Power Supply Loss Detection

LK414 provides function of field power supply loss detection.

As shown in Figure 5.27, terminal "17" connects to the positive end of field power supply while terminal "18" connects to its negative end. LK414 carries out power loss detection by checking the changes of input voltage between the two terminals. In case of any failure, the failure status will be reported to the controller as the diagnosis data.

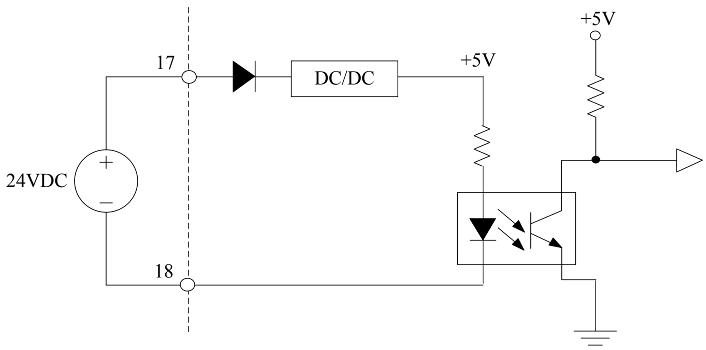


Figure 5.27: Field Power Loss Detection Circuit of LK414

- When the field 24VDC power supply failed, LK414 device diagnosis area generates diagnosis data "0x04" (Bit2=1 in Device Diagnosis Byte, indicating the field power supply loss), and reports to the controller.
- When the field 24VDC power supply recovered, the device diagnosis area generates diagnosis data "0x00" (Bit2=0 in Device Diagnosis Byte, indicating that the field power supply is recovered), and reports to the controller.
- LK414 module will only report the diagnosis data once respectively when failure occurs and is recovered.
- During the power loss, signal input channels retain the data before the failure occurred.

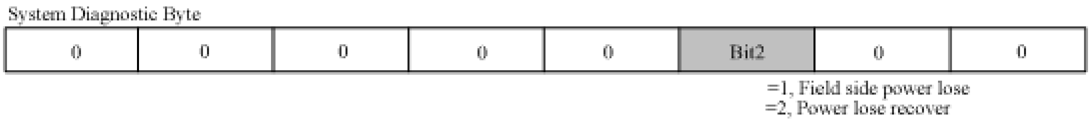


Figure 5.28: Device Diagnosis Byte of LK414 Module

Measurement Range Exceeded Alarm

LK414 module provides the function of Measure Range Exceeded Alarm. When the input signals exceed the preset measurement range, Channel Diagnosis will report "Over Range", when the signal fell back into range again, it will report "Failure Recovered".

LK414 module will only report the diagnosis data once respectively when signals exceeded range and when the failure is recovered.

Special attention shall be taken that for LK414 module, the valid range is not the maximum measurement range. Therefore, the input signals may still be within the maximum range when they exceed the valid range.

When the input signal exceeds valid range but are still within the maximum measurement range, the channel will report the code value of the current signal as the measurement data; when the signal is higher than the 20.58mA, the channel will report code 0xFFFF as the measured data; when the signal is lower than 4mA, the channel will report code 0x0000.

Measurement Range	Range Exceeding	
	Over Range	Short of Range
4~20mA	>20mA	<4mA

Table 5.25: LK414 Definition of Range Exceeding

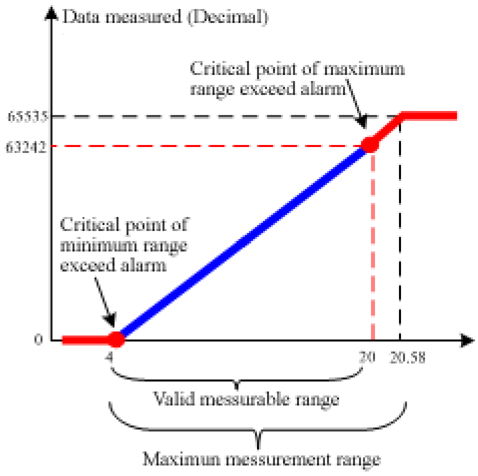


Figure 5.29: Range Exceeded Alarm of LK414

When input signals of one channel exceeded the range, the module will take processes as shown in Table 5.26. When signals fall back into the normal range, the channel will report diagnosis byte 0x00.

Maximum Measurement Range	Valid Range	Range Exceeding	Process of Range Exceeding
4~20.58mA	4~20mA	Over Range	Channel report diagnosis byte 0x03 20~20.58mA, the channel reports the code value 63242~65535 of the currently measured signal. >20.58mA, channel reports 65535
		Short of Range	Channel report diagnosis byte 0x02 channel reports 0 as measurement data

Table 5.26: LK414 Processes of Range Exceeded Signals

Limit Exceeded Alarm

LK414 module provides the function of Limits Exceeding Alarm. Users can configure the upper and lower alarm limits of input signals within the set measurement range. When input signals exceed the configured range, e.g. when they are higher than the upper alarm limit or lower than the lower limit, the channel will report diagnosis byte “exceed limits”. When input signals fall back into the configured range, the channel will report “failure recovered”.

LK414 module will only report the diagnosis data once respectively when signal exceeds limits and when the failure is recovered. The limit exceeded alarm of LK414 can be enabled through configuration software, the default setting of which is “disabled”. The alarm upper and lower limits of each channel can be defined by users. The upper alarm current limit shall be higher than the lower limit; otherwise LK414 module will not be able to correctly report diagnosis information. If the limit exceeded alarm is enabled, and the limit exceeding and range exceeding occur at the same time, LK414 will only report the exceeding of range.

Measurement Range	Alarm Signal
4~20mA	20mA>Current Upper Limit>Current Lower Limit>4mA

Table 5.27: Value Range of LK414 Alarm Limits

Represented by two bytes of positive integer codes (decimal 0~65535), the alarm value in the configuration is the machine code value of those measured signal within the set Measurement Range. The value range of the alarm upper limit is 1~65535 while its default value is 65535; the value range of the alarm lower limit is 0~65534 while its default value is 0.

Refer to the section on 5.4.5 Output Format of the Measurement Data for the detailed calculation.

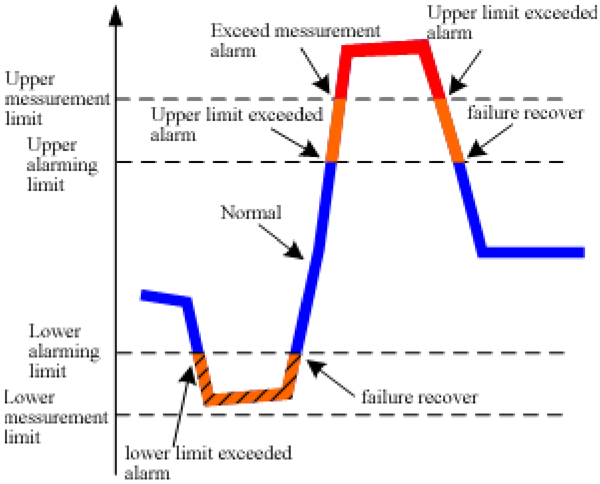


Figure 5.30: Limit Exceeded Alarm of LK414

In case the input signals of one channel exceed limit:

- When signals exceed the upper limit, the channel reports diagnosis byte 0x07
- When signals exceed the lower limit, the channel reports diagnosis byte 0x08
- The channel reports the code value of the currently measured signal.

- When signals fall back into the normal range, the channel reports diagnosis byte 0x00.

Detection of Line-break

LK414 module provides line-break detection function. When there is line-break in a signal input channel, the current of the channel will be lower than 0.1mA, the channel will report "Line-break". After the channel is reconnected, it will report "Failure Recovered".

LK414 module will only report the diagnosis data once respectively when line-break occurs and when the failure is recovered. If a input channel is not wired, it will be considered as disconnected. Therefore, for the channels not in use, it is suggested to disable the Line-break Alarm function, e.g. to keep the default value of parameter "Line Break Alarm".

When there is line-break of a channel:

- The channel will report diagnosis byte of line-break value 0x06
- channel reports 0x0000 as measurement data
- When the connection is recovered, the channel will report diagnosis byte 0x00

5.4.7 Parameter Specifications

The controller can only read and write the I/O information regularly after it entered data exchange mode. Therefore, in order to provide correct parameter information in the initialization process, users shall first set the parameters in the configuration software.

Communication Parameters

Supporting PROFIBUS-DP slave station protocol, LK414 completes data exchanges and diagnosis information reporting with the controller and other DP master stations. The slave station adopts a unique communication address, which is determined by the backplane number and the slot number of the LK414 module. The slave station address shall be correctly filled in the DP parameter field in the configuration software, as shown in Figure 5.31. Other communication parameters shall keep their default values.

Refer to Chapter 2: Backplanes for the calculation of the slave station address.

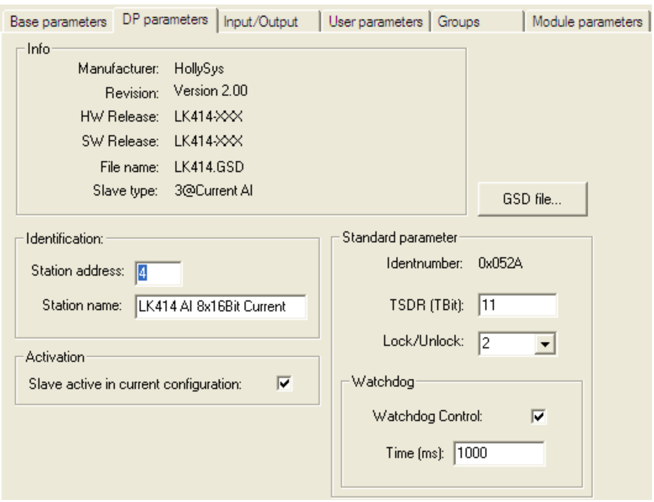


Figure 5.31: Setting of LK414 Communication Parameters

User Parameters

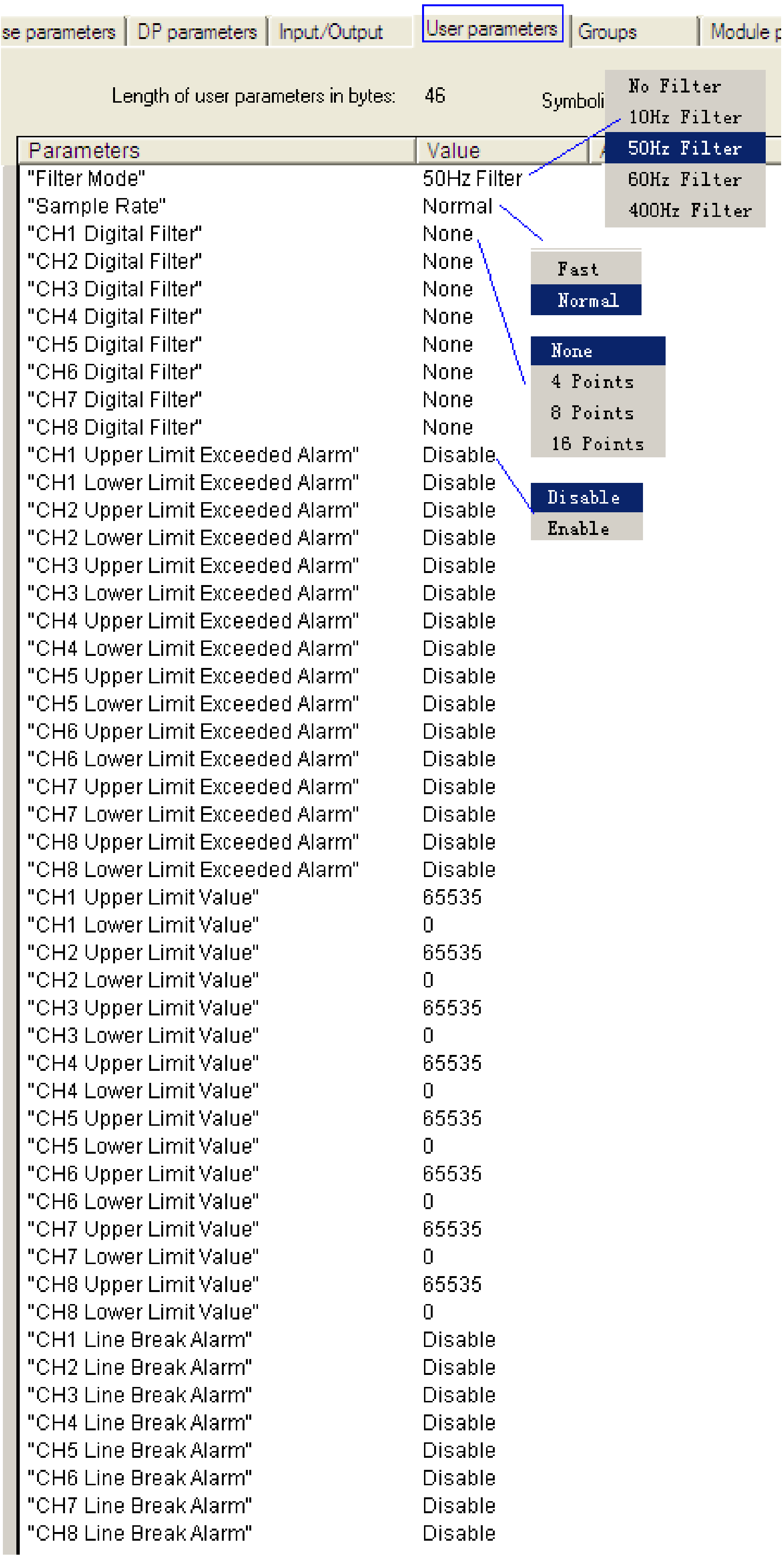
User parameters are used to configure the module's operating mode. They are written into the controller during the download of user program and will not be read in every scanning circle. Each parameter has a default value that can be changed according to requirements of the project. User parameters do not support online modification; therefore they can only be effective after the full download.

LK414 module has totally 38 bytes of user parameters.

Parameter Name	Parameter Definition	Parameter Value
Filter Mode	Parameter of Digital Filter Mode Selection	0=No Filter, no filter operation 1=10Hz Filter, filter of 10Hz interference

		2=50Hz Filter, filter of 50Hz interference (default value) 3=60Hz Filter, filter of 60Hz interference 4=400Hz Filter, filter of 400Hz interference
Sample Rate	Sample Rate Selection	0: Fast, the fastest sample rate; 1: Normal (Default value, drift control function enabled, but the internal sample time doubled)
CH1 Digital Filter	Software Filter Selection of Channel 1	0=None, no software filter (default value) 1=4Points, select 4 latest history points 2=8Points, select 8 latest history points 3=16Points, select 16 latest history points
CH2 Digital Filter	Software Filter Selection of Channel 2	
CH3 Digital Filter	Software Filter Selection of Channel 3	
CH4 Digital Filter	Software Filter Selection of Channel 4	
CH5 Digital Filter	Software Filter Selection of Channel 5	
CH6 Digital Filter	Software Filter Selection of Channel 6	
CH7 Digital Filter	Software Filter Selection of Channel 7	
CH8 Digital Filter	Software Filter Selection of Channel 8	
CH1 Upper Limit Exceeded Alarm	Enable the Upper Limit Exceeded Alarm of Channel 1	0: Disable, the alarm is disabled (default); 1: Enable, the alarm is enabled.
CH1 Lower Limit Exceeded Alarm	Enable the Lower Limit Exceeded Alarm of Channel 1	
CH2 Upper Limit Exceeded Alarm	Enable the Upper Limit Exceeded Alarm of Channel 2	
CH2 Lower Limit Exceeded Alarm	Enable the Lower Limit Exceeded Alarm of Channel 2	
CH3 Upper Limit Exceeded Alarm	Enable the Upper Limit Exceeded Alarm of Channel 3	
CH3 Lower Limit Exceeded Alarm	Enable the Lower Limit Exceeded Alarm of Channel 3	
CH4 Upper Limit Exceeded Alarm	Enable the Upper Limit Exceeded Alarm of Channel 4	
CH4 Lower Limit Exceeded Alarm	Enable the Lower Limit Exceeded Alarm of Channel 4	
CH5 Upper Limit Exceeded Alarm	Enable the Upper Limit Exceeded Alarm of Channel 5	
CH5 Lower Limit Exceeded Alarm	Enable the Lower Limit Exceeded Alarm of Channel 5	
CH6 Upper Limit Exceeded Alarm	Enable the Upper Limit Exceeded Alarm of Channel 6	
CH6 Lower Limit Exceeded Alarm	Enable the Lower Limit Exceeded Alarm of Channel 6	
CH7 Upper Limit Exceeded Alarm	Enable the Upper Limit Exceeded Alarm of Channel 7	
CH7 Lower Limit Exceeded Alarm	Enable the Lower Limit Exceeded Alarm of Channel 7	
CH8 Upper Limit Exceeded Alarm	Enable the Upper Limit Exceeded Alarm of Channel 8	
CH8 Lower Limit Exceeded Alarm	Enable the Lower Limit Exceeded Alarm of Channel 8	
CH1 Upper Limit Value	Setting the Alarm Upper Limit Value of Channel 1	Alarm Lower Limit Range: 0~65534 Alarm Upper Limit Range: 1~65535 Alarm Default Lower Limit: 0 Alarm Default Upper Limit: 65535
CH1 Lower Limit Value	Setting the Alarm Lower Limit Value of Channel 1	
CH2 Upper Limit Value	Setting the Alarm Upper Limit Value of Channel 2	
CH2 Lower Limit Value	Setting the Alarm Lower Limit Value of Channel 2	
CH3Upper Limit Value	Setting the Alarm Upper Limit Value of Channel 3	
CH3 Lower Limit Value	Setting the Alarm Lower Limit Value of Channel 3	
CH4 Upper Limit Value	Setting the Alarm Upper Limit Value of Channel 4	
CH4 Lower Limit Value	Setting the Alarm Lower Limit Value of Channel 4	
CH5 Upper Limit Value	Setting the Alarm Upper Limit Value of Channel 5	
CH5 Lower Limit Value	Setting the Alarm Lower Limit Value of Channel 5	
CH6 Upper Limit Value	Setting the Alarm Upper Limit Value of Channel 6	
CH6 Lower Limit Value	Setting the Alarm Lower Limit Value of Channel 6	
CH7 Upper Limit Value	Setting the Alarm Upper Limit Value of Channel 7	
CH7 Lower Limit Value	Setting the Alarm Lower Limit Value of Channel 7	
CH8 Upper Limit Value	Setting the Alarm Upper Limit Value of Channel 8	
CH8 Lower Limit Value	Setting the Alarm Lower Limit Value of Channel 8	
CH1 Line Break Alarm	Enabled the Line-break Alarm of Channel 1	0: Disable, the alarm is disabled (default); 1: Enable, the alarm is enabled.
CH2 Line Break Alarm	Enabled the Line-break Alarm of Channel 2	
CH3 Line Break Alarm	Enabled the Line-break Alarm of Channel 3	
CH4 Line Break Alarm	Enabled the Line-break Alarm of Channel 4	
CH5 Line Break Alarm	Enabled the Line-break Alarm of Channel 5	
CH6 Line Break Alarm	Enabled the Line-break Alarm of Channel 6	
CH7 Line Break Alarm	Enabled the Line-break Alarm of Channel 7	
CH8 Line Break Alarm	Enabled the Line-break Alarm of Channel 8	

Table 5.28: List of LK414 User Parameters



Parameters	Value
"Filter Mode"	50Hz Filter
"Sample Rate"	Normal
"CH1 Digital Filter"	None
"CH2 Digital Filter"	None
"CH3 Digital Filter"	None
"CH4 Digital Filter"	None
"CH5 Digital Filter"	None
"CH6 Digital Filter"	None
"CH7 Digital Filter"	None
"CH8 Digital Filter"	None
"CH1 Upper Limit Exceeded Alarm"	Disable
"CH1 Lower Limit Exceeded Alarm"	Disable
"CH2 Upper Limit Exceeded Alarm"	Disable
"CH2 Lower Limit Exceeded Alarm"	Disable
"CH3 Upper Limit Exceeded Alarm"	Disable
"CH3 Lower Limit Exceeded Alarm"	Disable
"CH4 Upper Limit Exceeded Alarm"	Disable
"CH4 Lower Limit Exceeded Alarm"	Disable
"CH5 Upper Limit Exceeded Alarm"	Disable
"CH5 Lower Limit Exceeded Alarm"	Disable
"CH6 Upper Limit Exceeded Alarm"	Disable
"CH6 Lower Limit Exceeded Alarm"	Disable
"CH7 Upper Limit Exceeded Alarm"	Disable
"CH7 Lower Limit Exceeded Alarm"	Disable
"CH8 Upper Limit Exceeded Alarm"	Disable
"CH8 Lower Limit Exceeded Alarm"	Disable
"CH1 Upper Limit Value"	65535
"CH1 Lower Limit Value"	0
"CH2 Upper Limit Value"	65535
"CH2 Lower Limit Value"	0
"CH3 Upper Limit Value"	65535
"CH3 Lower Limit Value"	0
"CH4 Upper Limit Value"	65535
"CH4 Lower Limit Value"	0
"CH5 Upper Limit Value"	65535
"CH5 Lower Limit Value"	0
"CH6 Upper Limit Value"	65535
"CH6 Lower Limit Value"	0
"CH7 Upper Limit Value"	65535
"CH7 Lower Limit Value"	0
"CH8 Upper Limit Value"	65535
"CH8 Lower Limit Value"	0
"CH1 Line Break Alarm"	Disable
"CH2 Line Break Alarm"	Disable
"CH3 Line Break Alarm"	Disable
"CH4 Line Break Alarm"	Disable
"CH5 Line Break Alarm"	Disable
"CH6 Line Break Alarm"	Disable
"CH7 Line Break Alarm"	Disable
"CH8 Line Break Alarm"	Disable

Figure 5.32: Setting of LK414 User Parameters

5.4.8 Module Installation and Un-installation

Refer to chapter 1 on "Module Insertion Mechanical keys" and "Module Insertion and Removable" for more details.

5.4.9 Technical Specification

<table>
<tr><td colspan="5">LK414 8-Channel Current External Powered AI Module</td></tr>
<tr><td colspan="5">System Power Supply</td></tr>
<tr><td colspan="2">Input Voltage</td><td colspan="3">24VDC(-15%~+20%)</td></tr>
<tr><td colspan="2">Power Consumption</td><td colspan="3">50mA max@24V DC</td></tr>
<tr><td colspan="5">Field Power Supply</td></tr>
<tr><td colspan="2">Input Voltage</td><td colspan="3">24VDC</td></tr>
<tr><td colspan="2">Power Consumption</td><td colspan="3">25mA max.×8 channels @24V DC</td></tr>
<tr><td colspan="5">Input Channel</td></tr>
<tr><td colspan="2">Channel Number</td><td colspan="3">8 channels, can supply power for two-wire transformers</td></tr>
<tr><td rowspan="2">Measurement Range</td><td>Current Signal</td><td colspan="3">4~20mA</td></tr>
<tr><td>Data Format</td><td colspan="3">0x0000~0xF70A</td></tr>
<tr><td rowspan="2">Maximum Measurement Range</td><td>Current Signal</td><td colspan="3">4~20.58mA</td></tr>
<tr><td>Data Format</td><td colspan="3">0x0000~0xFFFF</td></tr>
<tr><td colspan="2">Input Impedance</td><td colspan="3">239Ω</td></tr>
<tr><td colspan="2">ADC Bits</td><td colspan="3">16 bits</td></tr>
<tr><td rowspan="4">Sample Period (without software filter)</td><td rowspan="2">Hardware Filtering of 50Hz Interference</td><td>Chop Enabled</td><td colspan="2">960ms/8channel</td></tr>
<tr><td>Chop Disabled</td><td colspan="2">480ms/8channel</td></tr>
<tr><td rowspan="2">Hardware Filtering of 60Hz Interference</td><td>Chop Enabled</td><td colspan="2">800ms/8channel</td></tr>
<tr><td>Chop Disabled</td><td colspan="2">400ms/8channel</td></tr>
<tr><td colspan="2">Differential Mode Suppression Rate</td><td colspan="3">80dB</td></tr>
<tr><td colspan="2">Integral Mode Suppression Rate</td><td colspan="3">100dB</td></tr>
<tr><td colspan="2">Calibration Precision</td><td colspan="3">0.03% F.S.@25ºC</td></tr>
<tr><td colspan="2">Measurement Precision</td><td colspan="3">0.1% F.S.@25ºC</td></tr>
<tr><td colspan="2">Step Response Time</td><td colspan="3">Less than 1 seconds to reach 90% of target value</td></tr>
<tr><td colspan="2">Temperature Drift</td><td colspan="3">±25ppm/ºC</td></tr>
<tr><td colspan="2">Isolation Voltage between Field Channels and the System</td><td colspan="3">500V AC 1min Testing, Current Leak 5mA</td></tr>
<tr><td colspan="5">Failure Diagnosis and Hot swap</td></tr>
<tr><td colspan="2">Channel Line-break Alarm</td><td colspan="3">Channel line-break (Enabled in Configuration), channel reports diagnosis byte 0x60. Connection recovered, channel reports 0x00</td></tr>
<tr><td colspan="2">Measurement Range Exceeded Alarm</td><td colspan="3">Signal exceed Range upper/lower limits, diagnosis byte reports 0x03/0x02</td></tr>
<tr><td colspan="2">Limit Exceeded Alarm</td><td colspan="3">Signal range exceeded Alarm upper/lower limits, diagnosis byte reports 0x07/0x08</td></tr>
<tr><td colspan="2">Field Power Supply Loss Detection</td><td colspan="3">Field power supply loss, channel reports diagnosis byte 0x04, channel retain the measurement data before power loss</td></tr>
<tr><td colspan="2">Hot swap</td><td colspan="3">Support</td></tr>
<tr><td colspan="5">Communication Bus</td></tr>
<tr><td colspan="2">protocol</td><td colspan="3">PROFIBUS-DP Slave Station, in accordance with IEC61158-3/EN50170 standards</td></tr>
<tr><td colspan="2">Baud Rate</td><td colspan="3">Baud Rate Options: 1.5Mbps, 500Kbps, 187.5Kbps, 93.75Kbps, 45.45Kbps, 31.25Kbps, 19.2Kbps, 9.6Kbps</td></tr>
<tr><td colspan="2">Media</td><td colspan="3">Communication bus is connected to the backplane through euro connector, hot redundant communication media</td></tr>
<tr><td colspan="5">Physical Features</td></tr>
<tr><td colspan="2">Mechanic Keys to Prevent Incorrect Insertion</td><td colspan="3">A1</td></tr>
<tr><td colspan="2">Installation Location</td><td colspan="3">LK local backplane or expansion backplane</td></tr>
<tr><td colspan="2">Dimension</td><td colspan="3">Width × Height × Depth = 35mm×100mm×100mm</td></tr>
<tr><td colspan="2">Casing Protection Level</td><td colspan="3">IEC60529 IP20</td></tr>
<tr><td colspan="2">Weight</td><td colspan="3">190g</td></tr>
<tr><td colspan="5">Working Environment</td></tr>
<tr><td colspan="2">Working Temperature</td><td colspan="3">0ºC~60ºC</td></tr>
<tr><td colspan="2">Working Relative Humidity</td><td colspan="3">5%~95%, no condensate</td></tr>
<tr><td colspan="2">Storage Temperature</td><td colspan="3">-40ºC~70ºC</td></tr>
<tr><td colspan="2">Storage relative Humidity</td><td colspan="3">5%~95%, no condensate</td></tr>
</table>

Table 5.29: Technical Specification of LK414 Module

5.5 LK412 [6-CHANNEL, ISOLATED CHANNEL AI MODULE]

5.5.1 Features

- 6 Channels of Analog input , channel-to-channel isolation
- Detection of Line-break
- Measurement Range: 0~20mA / 4~20mA / -10V~10V / 0~10V / 0~5V
- Maximum Range: 0~20.58mA / 4~20.58mA / -10.25V~10.25V / 0~10.25V / 0~5.125V
- Calibration on Field
- Limit Exceeded Alarm
- Measurement Range Exceeded Alarm
- System-to-Field Isolation
- Support ProfiBus-DP Slave Station Protocol
- Supports Hot Swap

5.5.2 Operation Principles

The 24V DC input power supply of LK412 module goes through the isolated DC/DC converter to output a ±15VDC power supply for the interface circuit (field circuit). In between channels are isolated. This interface circuit is connected to other circuits through optical couplers to enable the isolation between the field and the system.

After I/V conversion, filter circuits and A/D conversion, the input current signals will be converted into digital signals and uploaded to the controller through DP bus. The voltage signals will be put through voltage conversion, filter and A/D conversion to be converted into digital signals and uploaded to the controller through DP bus.

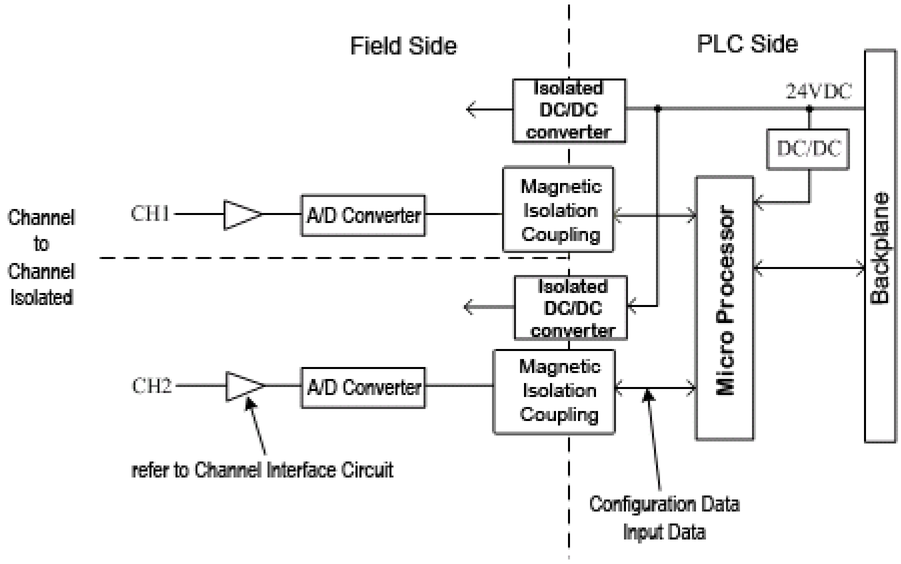


Figure 5.33: Internal Structure of LK412 Module

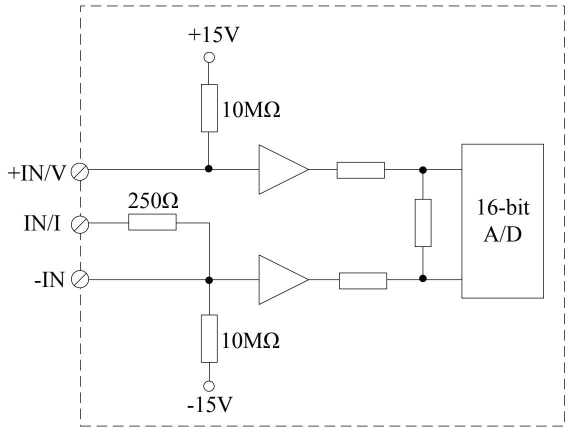


Figure 5.34: Channel Interface Circuit of LK412 Module

5.5.3 Indicators Definition

Refer to section 5.1.1: The LED Status indicator

5.5.4 Wiring Specifications

When connect to two-wire transformers, LK412 module does not supply power to external devices. Therefore, a separated 24V DC field power supply shall be adopted by each input channel to provide power to the transformer. To ensure the isolation between field and system, the field power supply shall be separated from the backplane power supply.

LK412 module can be installed on both the LK local backplanes and the expansion backplanes. The LK series backplanes support two types of wirings: terminal wiring and prefabricated cable wiring.

Wiring to Backplane Terminals

Channel Number	Terminal Number		
	Voltage Input Positive End (+IN/V)	Current Input (+IN/I)	Common Negative End
1	01	03/01	05
2	02	04/02	06
3	07	09/07	11
4	08	10/08	12
5	13	15/13	17
6	14	16/14	18

Table 5.30: Definitions of LK412 Backplane Wiring Terminals

In the wiring, the following shall be noted:

- The 18digit double wiring terminals shall be installed on the backplane, right under the installation slot of LK412 module.
- The measurement range of each channel can be configured separately, e.g. each channel can import either voltage signals or current signals.
- For current signals, Terminal 03 and Terminal 01 of Channel 1 can be short connected to be the positive end of current input, Terminal 04 and Terminal 02 of Channel 2 can be short connected to be the positive end of current input, terminal connections of other channels are similar.
- Each channel of the AI signals that come from the field is connected to its respective terminal through two (shielded) cables.
- The input channels do not supply power to the transformer; therefore a separated field 24V DC power supply will be needed when the module is connected to a two-wire transformer.
- After wiring, cable connections shall be checked to ensure the correct wiring. In order to avoid dangers such as short circuit, there shall be no nude cable outside of the terminals.

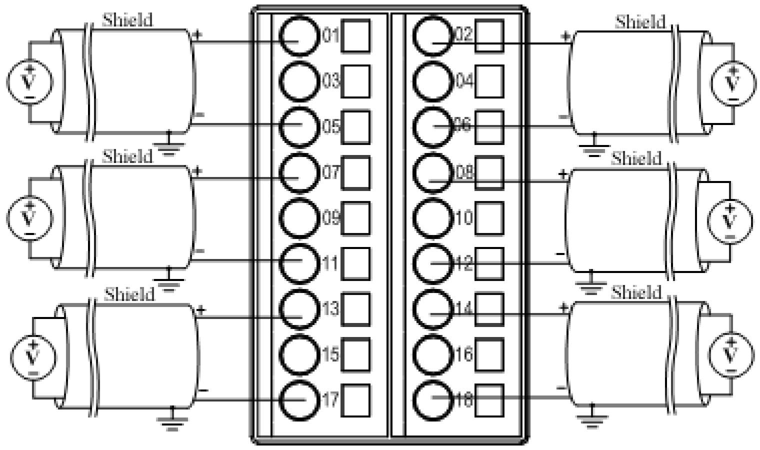


Figure 5.35: Wiring of LK412 Voltage Channel Terminals

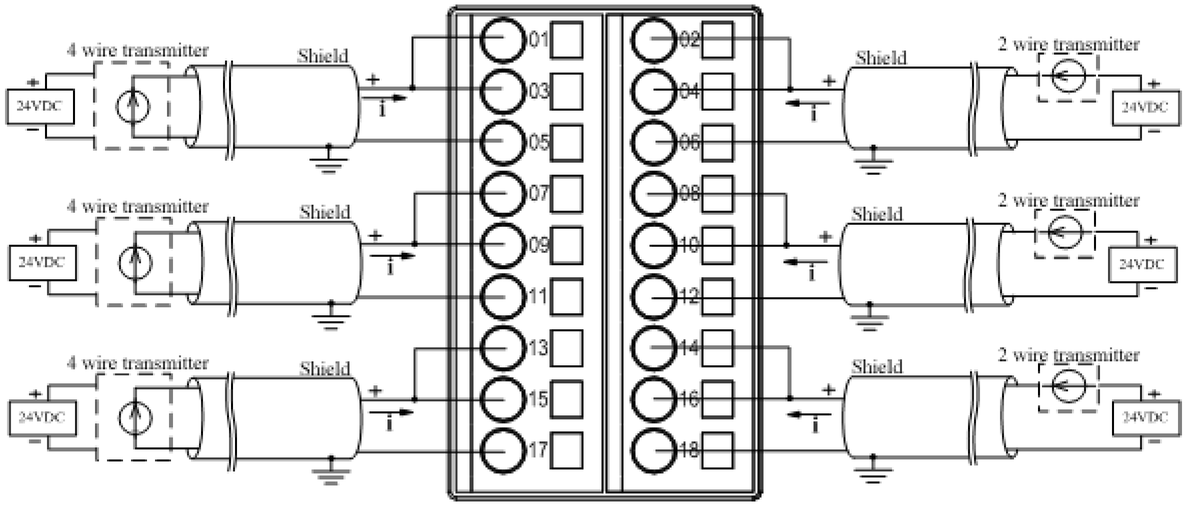


Figure 5.36: Wiring of LK412 Current Channel Terminals

Wiring to Terminal Modules

Please refer to the information found on Chapter 12: Terminal Module.

5.5.5 Function Specifications

Output Format of the Measurement Data

As shown in Table 5.42, the measurement data that reported through LK412 AI channels are represented by 2byte positive integer codes (decimal value range 0~65535). Among which, the voltage range (-10.25~+10.25V) are divided into two segments, the positive voltage (0~10.25V) signals are represented by decimal code value range 0~32767 while the negative voltage (-10.25~0) signals by decimal code value range 32768~65535.

Maximum Measurement Range		Decimal Code Value
-10.25~+10.25V	0~10.25V	0~32767
	-10.25V~0V	32768~65535
0~10.25V		0~65535
0~5.125V		0~65535
0~20.58mA		0~65535
4~20.58mA		0~65535

Table 5.31: The Corresponding Relation of LK412 Input Voltage and the Decimal Code

The measurement data of the range (-10.25~+10.25) can be converted to their corresponding codes by the following equation:

Positive voltage 0~+10.25: Voltage Value (V) = measurement data / 32767 × 10.25

Negative Voltage -10.25~0V: Voltage Value (V) = (measurement data -65535) / 32767 × 10.25

The function block HS_HEX_ENGIN in the analog conversion library HS_AnalogConvert.lib of the configuration software PowerPro V4 can be called to convert the 2 byte measurement value into engineering data. (Field side signals that being measured includes pressure, temperature and voltage, etc. Once users define the upper and lower limit of engineer units, function block will output the corresponding value according to the measurement value automatically.)

For detailed usage of the function block, please refer to the LK Series PLC - Instruction Manual.

To set the upper and lower alarm limits of user parameters, the voltage signals shall be converted into the format of decimal machine codes. For different ranges, the machine code conversion methods are different.

- **For the ranges of 0~10.25V, 0~5.125V and 0~20.58mA, the Signal conversion equation is as follow:**

*Machine Code Value = Signal × 65535 / Full Range Value**

** The Full Range Value measurement range equal to maximum measurable value minus minimum measurable value*

Take Channel 1 for example, if its measurement range is set as “0~10.25V”, the limit exceeding alarm is enabled and the user-defined upper and lower voltage limits are set as 10V and 5V, then the alarm upper limit shall be10×65535/10.25=63936 and the lower limit 5×65535/10.25=31968. The user parameter configuration is shown in Figure 5.52.

"CH1 Input Range"	0~10.25V
"CH1 Upper Limit Exceeded Alarm"	Enable
"CH1 Lower Limit Exceeded Alarm"	Enable
"CH1 Upper Limit Value"	63936
"CH1 Lower Limit Value"	31968

Figure 5.37: Example of Parameter Setting in Set Range under Programming Mode

- **For the ranges of 4~20.58mA, the signal and code value conversion equation is as follow:**

Code Value = (Current Signal - 4) × 65535 / 16.58

Take Channel 2 for example, if its measurement range is set as “4~20.58mA”, the limit exceeded alarm is enabled and the user-defined upper and lower current limits are set as 15mA and 5mA, then the alarm upper limit shall be(15-4)×65535/16.58=43479 and the lower limit (5-4)×65535/16.58=3952. The user parameter configuration is shown in Figure 5.53.

"CH1 Input Range"	4~20.58mA
"CH1 Upper Limit Exceeded Alarm"	Enable
"CH1 Lower Limit Exceeded Alarm"	Enable
"CH1 Upper Limit Value"	43479
"CH1 Lower Limit Value"	3952

Figure 5.38: Example of Parameter Setting in Set Range under Programming Mode

- **For the ranges of -10.25~+10.25V, the signal and code conversion equation is as follow:**

Positive Voltage Range (0~10.25): Machine Code Value = Positive Voltage Signal ×32767/10.25

Negative Voltage Range (-10.25~0V): Machine Code Value = 65535 + (Negative Voltage Signal ×32767/10.25)

Take Channel 3 for example, if its measurement range is set as “-10.25~+10.25V”, the limit exceeding alarm is enabled and the user-defined upper and lower voltage limits are set as 10V and -10V, then the alarm upper limit shall be10×32767/10.25=31968 and the lower limit 65535+（-10×32767/10.25)V=33567. The user parameter configuration is shown in Figure 5.54.

"CH3 Input Range"	-10.25~10.25V
"CH3 Upper Limit Exceeded Alarm"	Enable
"CH3 Lower Limit Exceeded Alarm"	Enable
"CH3 Upper Limit Value"	31968
"CH3 Lower Limit Value"	33567

Figure 5.39: Example of Parameter Setting in Set Range under Programming Mode

5.5.6 Specifications of Diagnosis

PowerPro V4 configuration software adopts external diagnosis library to check and acquire all kinds of diagnosis information, such as whether the module and its channels are operating normally and whether the module parameters are set correctly.

For the DP slave station modules, the DP slave station expansion diagnosis function block (HS_DPSlaveALarm) shall be called to check the DP module at any address on the PROFIBUS-DP link, as shown in Figure 5.55.

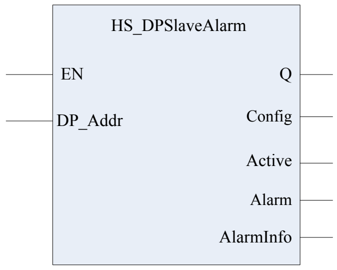


Figure 5.40: Expansion Diagnosis Function Block for DP Slave Station

For detailed usage of DP Expansion Diagnosis Function Block, please refer to LK Large Scale PLC Instruction Manual. Users shall note that the Diagnosis library is an external library that shall be first installed in the Library Manager before use.

The diagnosis information of DP slave station modules can be classified to 3 categories: device diagnosis, identifier diagnosis and channel diagnosis. All diagnosis data exist in the form of block structure.

- **Device Diagnosis:** records of the overall diagnosis information of the module, such as, power loss of field power supply.
- **Identifier Diagnosis:** records of whether the module has diagnosis information.
- **Channel Diagnosis:** records of the channel level diagnosis information, such as line-break and rang exceeding.

Channel diagnoses such as those of range exceeding, limit exceeding and line-break may be applied to LK412 signal input channels. Device diagnoses such the field power supply failure checking can be applied on the power supply channel. After the DP slave station expansion diagnosis function block (HS_DPSlaveAlarm) is called, the channel diagnosis and device diagnosis data reported by LK412 will be stored in the corresponding fields of the output parameter "AlarmInfo", as shown in Table 5.43.

Diagnosis Information		Value	Definition
Device Diagnosis	DevDiag.Data[1]	2	Calibration data error
		0	No Error in Calibration data
Channel Diagnosis	ChDiag.Module.Channel.ChNo	1~8	Channel Number of the Failure
	ChDiag.Module.Channel.Error	2	Short of Range
		3	Over Range
		6	Line-Break
		7	Upper Limit Exceeded
		8	Lower Limit Exceeded
		0	Channel Failure Recovered

Table 5.32: Definition of LK412 Diagnosis Information

Calibration Data Error Diagnosis

- Calibration data error diagnosis is a kind of device diagnoses. After power on, the module reads the calibration data in the storage. In the reading, if there is any error of the calibration data, the device diagnosis data area will generate a diagnosis byte "0x02" (Bit=1 in diagnosis byte) and report it to the controller.

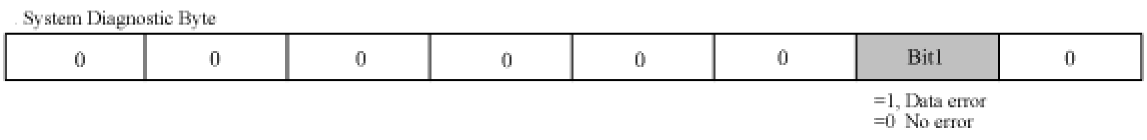


Figure 5.41: Device Diagnosis Byte of LK510 Module

- After the DP slave station expansion diagnosis function block (HS_DPSlaveAlarm) is called, the device diagnosis data reported by LK510 will be stored in the corresponding fields of the output parameter "AlarmInfo", as shown in Table 6.2.

Diagnosis Information		Value	Definition
Device Diagnosis	ALarmInfo.DevDiag.Data[1]	0X02	Calibration Data Error
		0x00	No Error in Calibration Data

Table 5.33: Definition of LK510 Diagnosis Information

- When error occurs in calibration data, the output voltage then may not meet the precision requirement. The module shall be re-swamped or re-calibrated. If the calibration error persists, the module shall be changed.
- The diagnosis of calibration data error will only be executed when the module is just turn on. This diagnosis will not be carried out when module begins its normal operation.

Measurement Range Exceeded Alarm

- LK412 module provides the function of Measurement Range Exceeded Alarm. When the input signals exceed the preset measurement range, Channel Diagnosis will report “Over Range”, when the signal fell back into range again, it will report “Failure Recovered”.
- LK412 module will only report the diagnosis data once respectively when signals exceeded range and when the failure is recovered.
- Special attention shall be taken that for LK412 module, the valid range is not the maximum measurement range. Therefore, the input signals may still be within the maximum range when they exceed the valid range.
- When the input signal exceeds valid range but are still within the maximum measurement range, the channel will report the code value of the current signal as the measured data; when the signal is higher than the maximum measurable range, the code value of the maximum measurable signal will be reported as the measured data; when the signal is lower than the minimum measurable range, the channel will report the code value of the minimum measurable signal.

Measurement Range	Range Exceeding	
	Over Range	Short of Range
0~20mA	>20mA	<0mA
4~20mA	>20mA	<4mA
-10V~10V	>10V	<-10V
0~10V	>10V	<0V
0~5V	>5V	<0V

Table 5.34: LK412 Definition of Range Exceeding

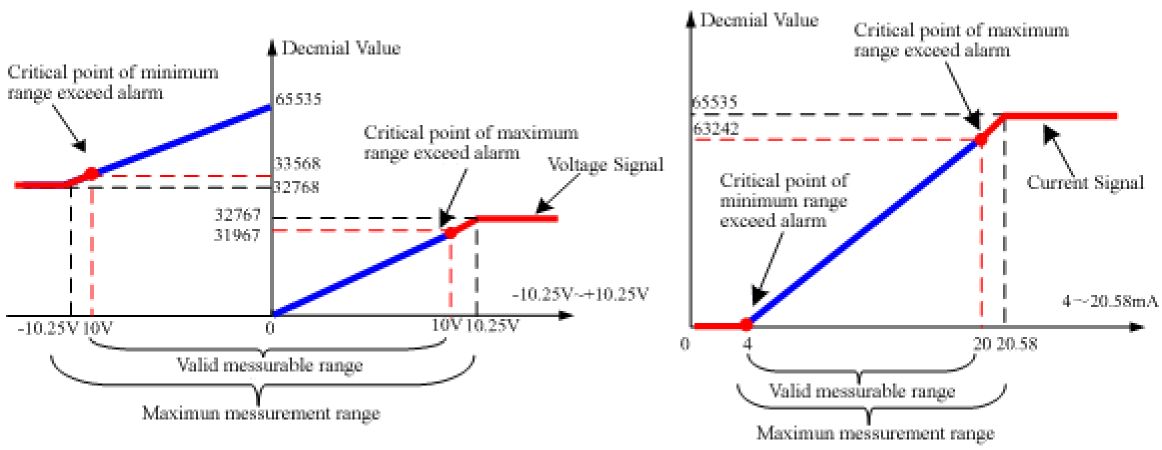


Figure 5.42: Range Exceeded Alarm Diagnosis of LK412

- As for different ranges set by users, the module provides different diagnosis processes of rang exceeding, as shown in Table 5.45. When signals fall back into the normal range, the channel will report diagnosis byte 0x00.

Maximum Measurement Range	Measurement Range	Range Exceeding	Process of Range Exceeding
0~20.58mA	0~20mA	Over Range	Channel report diagnosis byte 0x03 20~20.58mA, channel reports the code values 63688~65535 of the measured data >20.58mA, channel reports 65535
		Short of Range	Channel report diagnosis byte 0x02 Channel reports 0 as measurement data
4~20.58mA	4~20mA	Over Range	Channel report diagnosis byte 0x03 20~20.58mA, channel reports the code values 63242~65535 of the measured data >20.58mA, channel reports 65535

		Short of Range	Channel report diagnosis byte 0x02 Channel reports 0 as measurement data
-10.25V~10.25V	-10V~10V	Over Range	Channel report diagnosis byte 0x03 10~10.25V, Channel reports the code value 31967~32767 of the measured data >10.25V, channel reports 32767
		Short of Range	Channel report diagnosis byte 0x02 -10.25~-10V, Channel reports the code value 32767~33568 of the measured data <-10.25V, channel reports 32768
0~10.25V	0~10V	Over Range	Channel report diagnosis byte 0x03 10~10.25V, channel reports the code values 63937~65535 of the measured data >10.25V, channel reports 65535
		Short of Range	Channel report diagnosis byte 0x02 Channel reports 0 as measurement data
0~5.125V	0~5V	Over Range	Channel report diagnosis byte 0x03 5~5.125V, channel reports the code values 63937~65535 of the measured data >5.125V, channel reports 65535
		Short of Range	Channel report diagnosis byte 0x02 Channel reports 0 as measurement data

Table 5.35: LK412 Processes of Rang Exceeded Alarm in Different Ranges

Limit Exceeded Alarm

- LK412 module provides the function of Limits Exceeding Alarm. When input signals exceed the configured range, e.g. when they are higher than the upper alarm limit or lower than the lower limit, the channel will report diagnosis byte “exceed limits”. When input signals fall back into the configured range, the channel will report “failure recovered”.
- LK412 module will only report the diagnosis data once respectively when signal exceeds limits and when the failure is recovered.
- The upper alarm current limit shall be higher than the lower limit; otherwise LK412 module will not be able to correctly report diagnosis information. If the limit exceeded alarm is enabled, and the limit exceeding and range exceeding occur at the same time, LK414 will only report the exceeding of range.

Measurement Range	Setting of Alarm Value
0~20mA	20mA>Current Upper Limit>Current Lower Limit>0mA
4~20mA	20mA>Current Upper Limit>Current Lower Limit>4mA
-10V~10V	10V>Upper Limit Voltage>Lower Limit Voltage>-10V
0~10V	10V>Upper Limit Voltage>Lower Limit Voltage>0V
0~5V	5V>Upper Limit Voltage>Lower Limit Voltage>0V

Table 5.36: Value Range of LK412 Alarm Limits

- Represented by two bytes of positive integer codes, the alarm value in the configuration is the machine code value of those measured signal within the set Measurement Range. The value range of the upper alarm limit is 1~65535 and the default value is 32767. The value range of the lower alarm limit is 0~65534 and the default value is 0. Their calculation equations are as shown in Table 5.47.

Measurement Range		Upper Alarm Limit Code (Decimal)	Lower Alarm Limit Code (Decimal)
0~20.58mA		Upper Limit Current×65535/20.58	Lower Limit Current×65535/20.58
4~20.58mA		(Upper Limit Current-4)×65535/16.58	(Lower Limit Current-4)×65535/16.58
±10.25V	-10.25-0V	65535 + (Lower Limit Voltage×32767/10.25)	65535 + (Lower Limit Voltage×32767/10.25)
	0~10.25V	Upper Limit Voltage×32767/10.25	Lower Limit Voltage×32767/10.25
0~10.25V		Upper Limit Voltage×65535/10.25	Lower Limit Voltage×65535/10.25
0~5.125V		Upper Limit Voltage×65535/5.125	Lower Limit Voltage×65535/5.125

Table 5.37: Calculation of LK412 Alarm Limit Value Codes

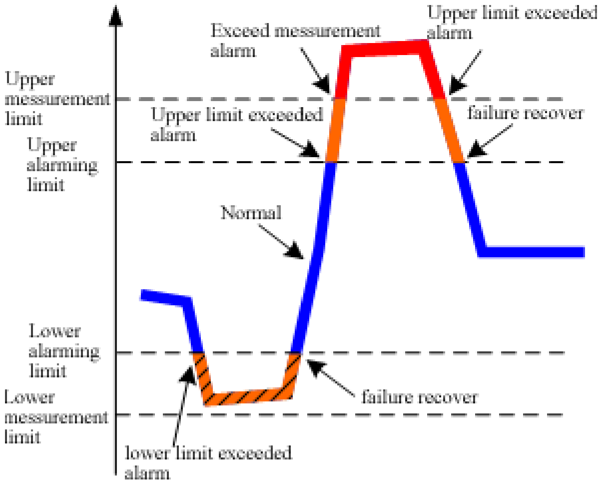
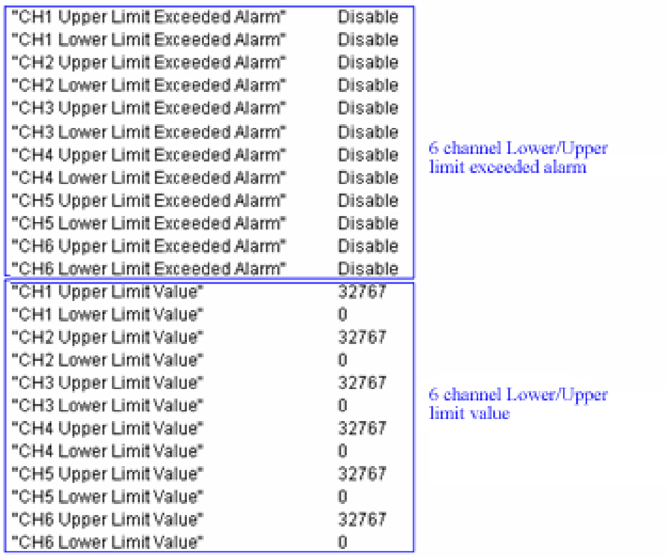


Figure 5.43: Limit Exceeded Alarm Diagnosis of LK412

- In case the input signals of one channel exceed limit:
  - When signals exceed the upper limit, the channel reports diagnosis byte 0x07
  - When signals exceed the lower limit, the channel reports diagnosis byte 0x08
  - The channel reports the code value of the currently measured signal.
  - When signals fall back into the normal range, the channel reports diagnosis byte 0x00.
  - The lower limit exceeded alarm function is enabled by the configuration of parameter “CH1~CH6 Lower Limit Exceeded Alarm” while the upper limit exceeded alarm function is enabled by the configuration of parameter “CH1~CH6 Upper Limit Exceeded Alarm”. The default configurations of both are “disabled”. When the alarm functions are enabled, the lower and upper alarm limits can be set through parameters “CH1~CH6 Lower Limit value” and “CH1~CH6 Upper Limit Value”.
  - The limit exceeded alarm function, upper and lower alarm limits of the 6 channels are configured separately.



"CH1 Upper Limit Exceeded Alarm"	Disable
"CH1 Lower Limit Exceeded Alarm"	Disable
"CH2 Upper Limit Exceeded Alarm"	Disable
"CH2 Lower Limit Exceeded Alarm"	Disable
"CH3 Upper Limit Exceeded Alarm"	Disable
"CH3 Lower Limit Exceeded Alarm"	Disable
"CH4 Upper Limit Exceeded Alarm"	Disable
"CH4 Lower Limit Exceeded Alarm"	Disable
"CH5 Upper Limit Exceeded Alarm"	Disable
"CH5 Lower Limit Exceeded Alarm"	Disable
"CH6 Upper Limit Exceeded Alarm"	Disable
"CH6 Lower Limit Exceeded Alarm"	Disable
"CH1 Upper Limit Value"	32767
"CH1 Lower Limit Value"	0
"CH2 Upper Limit Value"	32767
"CH2 Lower Limit Value"	0
"CH3 Upper Limit Value"	32767
"CH3 Lower Limit Value"	0
"CH4 Upper Limit Value"	32767
"CH4 Lower Limit Value"	0
"CH5 Upper Limit Value"	32767
"CH5 Lower Limit Value"	0
"CH6 Upper Limit Value"	32767
"CH6 Lower Limit Value"	0

Figure 5.44: Limit Exceeded Alarm Parameters of LK412

Detection of Line-break

- LK412 module provides line-break detection function.
- As shown in Figure 5.59, a 10MΩ pull-up resistor is connected to the signal channel. LK412 detects line-break by checking changes of the input voltage between two wiring terminals. In case of any failure, the failure status will be reported to the controller as the diagnosis data. When there is line-break in an input channel, the positive-end voltage of the channel will be pulled up to +15V and the negative-end voltage will be pulled down to -15V, then the voltage difference on the input-end of AD transfer will reach the maximum value, the channel will report “Line-break”. After the channel is reconnected, it will report “Failure Recovered”.
- LK412 module will only report the diagnosis data once respectively when line-break occurs and when the failure is recovered. The line-break alarm can be enabled through configuration software. By default, it is set as disabled. If an input channel is not wired, it will be considered as disconnected. Therefore, for the channels not in use, it is suggested to disable the Line-break Alarm function, e.g. to keep the default value of parameter “Line Break Alarm”.

➢ When line-break occurred in a channel, the module provides different diagnosis processes for different ranges set by users, as shown in Table 5.48. When the connection is recovered, the channel will report diagnosis byte 0x00

Signal Type	Line-break	Processes of Line-break
Current Signal	Line-break of short connected cable (+IN/V)	Channel reports diagnosis byte of failure value 0x06 Channel reports 65535 as measurement data
	Line-break of field signal cable (+IN/I, -IN)	Channel reports diagnosis byte of line-break value 0x06 Channel reports 0 as measurement data
Voltage Signal	Line-break of field signal cable (+IN/V, -IN)	Channel reports diagnosis byte of line-break value 0x06 Channel reports 65535 or 32767 (-10.25~10.25V Range) as the measurement data

Table 5.38: LK412 Processes of Line-break for Different Signal Types

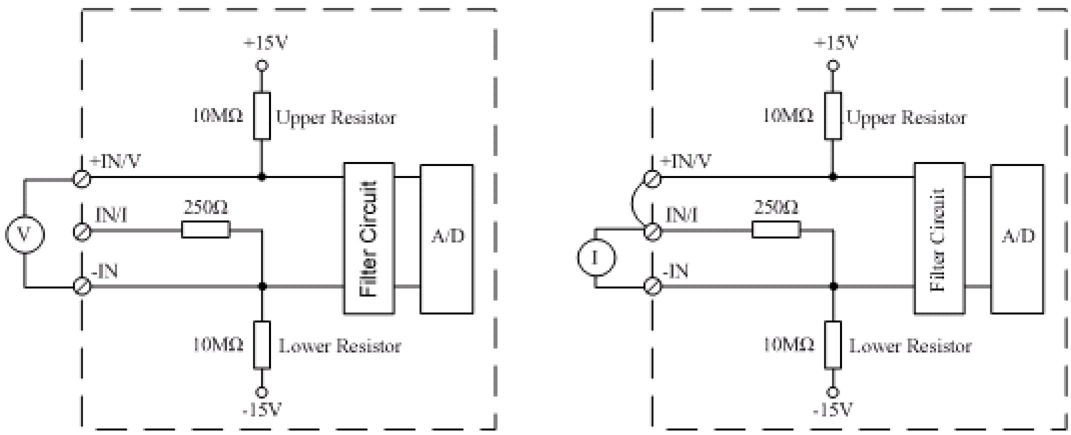


Figure 5.45: LK412 Detection Circuit of Channel Line-break

5.5.7 Parameter Specifications

The controller can only read and write the I/O information regularly after it entered data exchange mode. Therefore, in order to provide correct parameter information in the initialization process, users shall first set the parameters in the configuration software.

Communication Parameters

➢ Supporting PROFIBUS-DP slave station protocol, LK412 completes data exchanges and diagnosis information reporting with the controller and other DP master stations. The slave station adopts a unique communication address, which is determined by the backplane number and the slot number of the LK412 module. The slave station address shall be correctly filled in the DP parameter field in the configuration software, as shown in Figure 5.60. Other communication parameters shall keep their default values.

Please also refer to Chapter 2: Backplanes for the calculation of station number.

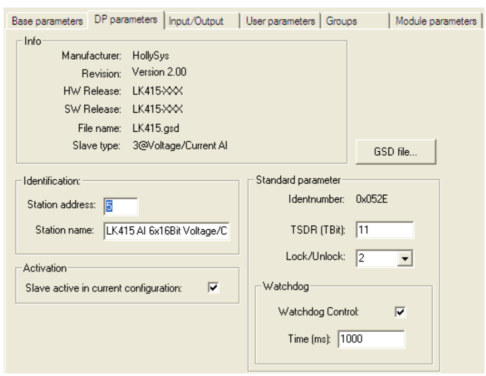


Figure 5.46: Setting of LK412 Communication Parameters

User Parameters

➢ User parameters are used to configure the module's operating mode. They are written into the controller during the download of user program and will not be read in every scanning circle. Each parameter has a default value that can be

changed according to requirements of the project. User parameters do not support online modification; therefore they can only be effective after the full download.

- LK412 module has totally 36 bytes of user parameters.

Parameter Name	Parameter Definition	Parameter Value
Filter Mode	Parameter of Digital Filter Mode Selection	0=No Filter, no filter operation 1=10Hz Filter, filter of 10Hz interference 2=50Hz Filter, filter of 50Hz interference (default value) 3=60Hz Filter, filter of 60Hz interference 4=400Hz Filter, filter of 400Hz interference
Sample Rate	Sample Rate Selection	0: Fast, the fastest sample rate; 1: Normal (Default value, drift control function enabled, but the internal sample time doubled)
CH1 Input Range	Range Selection of Channel 1 (The setting of "Range Selection" for individual channel would not affect others. It is allowed to have different "Range Selection" setting for different channels.)	16=-10.25~10.25V (Default); 17=0~10.25V; 18=0~5.125V; 70=0~20.58mA 71=4~20.58mA
CH2 Input Range	Range Selection of Channel 2	
CH3 Input Range	Range Selection of Channel 3	
CH4 Input Range	Range Selection of Channel 4	
CH5 Input Range	Range Selection of Channel 5	
CH6 Input Range	Range Selection of Channel 6	
CH1 Digital Filter	Software Filter Selection of Channel 1 (The setting of "Software filter Selection" for individual channel would not affect others. It is allowed to have different "Software filter Selection" setting for different channels.)	0=None, no software filter (default value) 1=4Points, select 4 latest history points 2=8Points, select 8 latest history points 3=16Points, select 16 latest history points
CH2 Digital Filter	Software Filter Selection of Channel 2	
CH3 Digital Filter	Software Filter Selection of Channel 3	
CH4 Digital Filter	Software Filter Selection of Channel 4	
CH5 Digital Filter	Software Filter Selection of Channel 5	
CH6 Digital Filter	Software Filter Selection of Channel 6	
CH1 Upper Limit Exceeded Alarm	Enable the Upper Limit Exceeded Alarm of Channel 1	0=Disable, the alarm is disabled (default); 1= Enable, the alarm is enabled.
CH1 Lower Limit Exceeded Alarm	Enable the Lower Limit Exceeded Alarm of Channel 1	
CH2 Upper Limit Exceeded Alarm	Enable the Upper Limit Exceeded Alarm of Channel 2	
CH2 Lower Limit Exceeded Alarm	Enable the Lower Limit Exceeded Alarm of Channel 2	
CH3 Upper Limit Exceeded Alarm	Enable the Upper Limit Exceeded Alarm of Channel 3	
CH3 Lower Limit Exceeded Alarm	Enable the Lower Limit Exceeded Alarm of Channel 3	
CH4 Upper Limit Exceeded Alarm	Enable the Upper Limit Exceeded Alarm of Channel 4	
CH4 Lower Limit Exceeded Alarm	Enable the Lower Limit Exceeded Alarm of Channel 4	
CH5 Upper Limit Exceeded Alarm	Enable the Upper Limit Exceeded Alarm of Channel 5	
CH5 Lower Limit Exceeded Alarm	Enable the Lower Limit Exceeded Alarm of Channel 5	
CH6 Upper Limit Exceeded Alarm	Enable the Upper Limit Exceeded Alarm of Channel 6	
CH6 Lower Limit Exceeded Alarm	Enable the Lower Limit Exceeded Alarm of Channel 6	
CH1 Upper Limit Value	Setting the Alarm Upper Limit Value of Channel 1	Alarm Lower Limit Range: 0~65534 Alarm Upper Limit Range: 1~65535 Alarm Default Lower Limit: 0 Alarm Default Upper Limit: 32767
CH1 Lower Limit Value	Setting the Alarm Lower Limit Value of Channel 1	
CH2 Upper Limit Value	Setting the Alarm Upper Limit Value of Channel 2	
CH2 Lower Limit Value	Setting the Alarm Lower Limit Value of Channel 2	
CH3 Upper Limit Value	Setting the Alarm Upper Limit Value of Channel 3	
CH3 Lower Limit Value	Setting the Alarm Lower Limit Value of Channel 3	
CH4 Upper Limit Value	Setting the Alarm Upper Limit Value of Channel 4	
CH4 Lower Limit Value	Setting the Alarm Lower Limit Value of Channel 4	
CH5 Upper Limit Value	Setting the Alarm Upper Limit Value of Channel 5	
CH5 Lower Limit Value	Setting the Alarm Lower Limit Value of Channel 5	
CH6 Upper Limit Value	Setting the Alarm Upper Limit Value of Channel 6	

CH6 Lower Limit Value	Setting the Alarm Lower Limit Value of Channel 6	
CH1 Line Break Alarm	Enabled the Line-break Alarm of Channel 1	0=Disable, the alarm is disabled; 1= Enable, the alarm is enabled.
CH2 Line Break Alarm	Enabled the Line-break Alarm of Channel 2	
CH3 Line Break Alarm	Enabled the Line-break Alarm of Channel 3	
CH4 Line Break Alarm	Enabled the Line-break Alarm of Channel 4	
CH5 Line Break Alarm	Enabled the Line-break Alarm of Channel 5	
CH6 Line Break Alarm	Enabled the Line-break Alarm of Channel 6	

Table 5.39: List of LK412 User Parameters

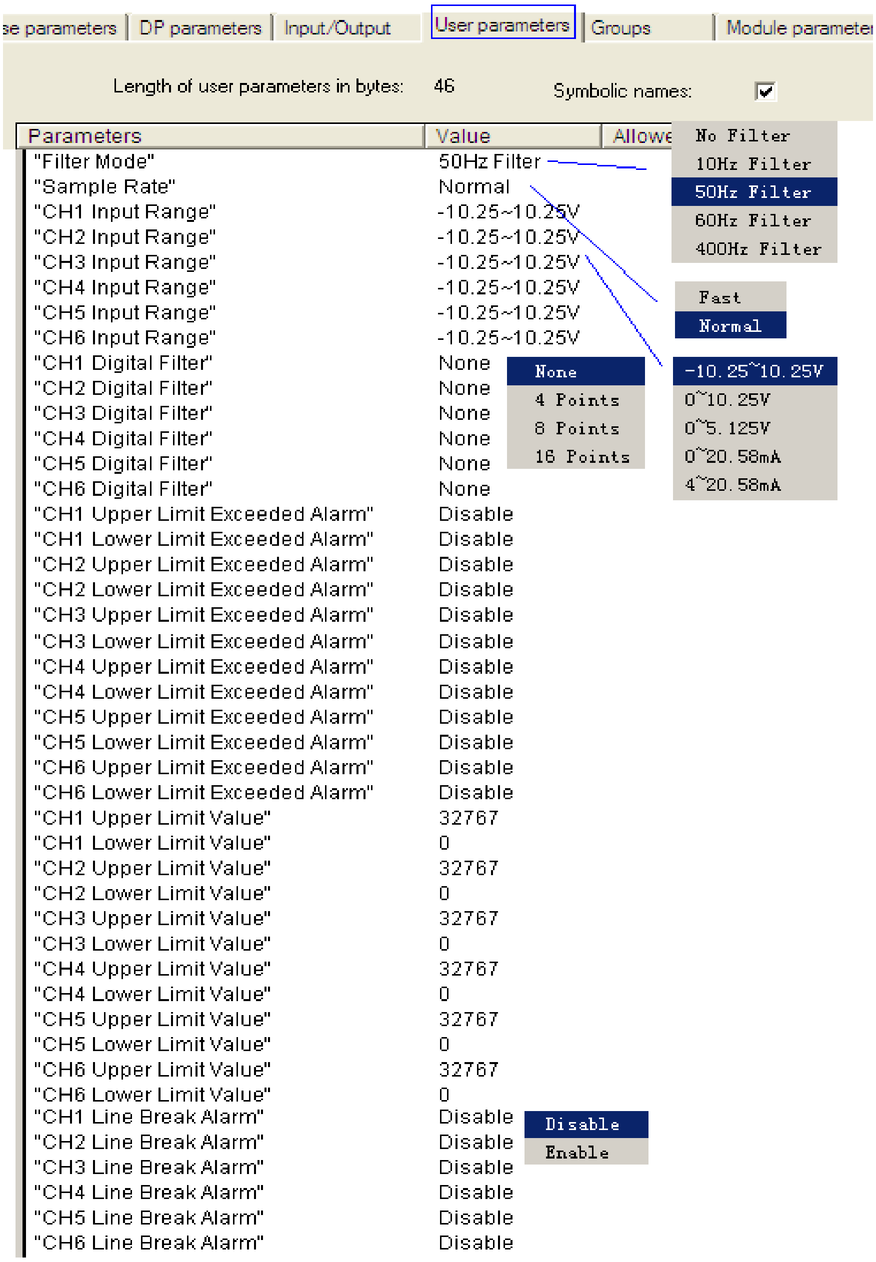


Figure 5.47: Setting of LK412 User Parameters

5.5.8 Module Installation and Un-installation

Refer to chapter 1 on "Module Insertion Mechanical keys" and "Module Insertion and Removable" for more details.

5.5.9 Technical Specification

LK412 [6-channel, Isolated Channel AI module]					
Power Supply					
Input Voltage		24VDC(-15%~+20%)			
Power Consumption		150mA@24VDC			
Input Channel					
Channel number		6			
Range Code		16		17	18
Maximum Measurement Range	Voltage Signal	-10.25~0V	0~10.25V	0~10.25V	0~5.125V
	Data Format	32768~65535	0~32767	0~65535	0~65535
Range Code		70		71	
Maximum Measurement Range	Current Signal	0~20.58mA		4~20.58mA	
	Data Format	0~65535		0~65535	
Input Impedance	Voltage Signal	>1MΩ			
	Current Signal	250Ω			
ADC resolution		16 bits			
All channel sampling period (without software filtering)		50ms max.			
Differential Mode Suppression Rate		<60dB			
Integral Mode Suppression Rate		<100dB			
Measurement Precision		0.1%F.S.			
Iteration Precision		0.02%F.S.			
Calibration Precision (25ºC)		0.03%F.S.			
Calibration Interval		12 months			
Step Response Time		Less than 1 second to reach 90% of target value			
Temperature Drift		±25ppm/ºC			
Failure Diagnosis and Hot swap					
Calibration data error diagnosis		When power-on, calibration data error, diagnosis byte reports 0x02; no report when no error.			
Measurement Range Exceeded Alarm		Signal exceed Range upper/lower boundaries, diagnosis byte reports 0x03/0x02			
Limit Exceeded Alarm		Signal exceed Alarm upper/lower limits, diagnosis byte reports 0x07/0x08			
Detection of Line-break		Line-break, channel reports diagnosis byte 0x06. Connection recovered, channel reports 0x00			
Hot swap		Support			
Isolation Voltage					
Channel to System		500V AC 1min Testing, Current Leak 5mA			
Channel to Channel		500V AC 1min Testing, Current Leak 5mA			
Communication					
Protocol		PROFIBUS-DP Slave Station, in accordance with IEC61158-3/EN50170 standards			
Baud Rate		1.5Mbps, 500Kbps, 7.5Kbps, 93.75Kbps, 45.45Kbps, 31.25Kbps, 19.2Kbps, 9.6Kbps			
Media		Communication bus is connected to the backplane through euro connector, hot redundant communication media			
Physical Features					
Mechanic Keys to Prevent Incorrect Insertion		A0			
Installation Location		LK local backplane or expansion backplane			
Dimension		Width × Height × Depth = 35mm×100mm×100mm			
Casing Protection Level		IEC60529 IP20			
Weight		190g			
Working Environment					
Working Temperature		0ºC~60ºC			
Working Relative Humidity		5%~95%, no condensate			
Storage Temperature		-40ºC~70ºC			
Storage relative Humidity		5%~95%, no condensate			

Table 5.40: Technical Specification of LK412 Module

5.6 LK415 [6-CHANNEL AI MODULE]

5.6.1 Features

- 6 Channels of Analog input
- Measurement Range: 0~20mA / 4~20mA / -10V~10V / 0~10V / 0~5V
- Maximum Range: 0~20.58mA / 4~20.58mA / -10.25V~10.25V / 0~10.25V / 0~5.125V
- Calibration on Field
- Measurement Range Exceeded Alarm
- Support ProfiBus-DP Slave Station Protocol
- Detection of Line-break
- Limit Exceeded Alarm
- System-to-Field Isolation
- Supports Hot Swap

5.6.2 Operation Principles

The 24V DC input power supply of LK415 module goes through the isolated DC/DC converter to output a ±15VDC power supply for the interface circuit (field circuit). This interface circuit is connected to other circuits through optical couplers to enable the isolation between the field and the system.

After I/V conversion, filter circuits and A/D conversion, the input current signals will be converted into digital signals and uploaded to the controller through DP bus. The voltage signals will be put through voltage conversion, filter and A/D conversion to be converted into digital signals and uploaded to the controller through DP bus.

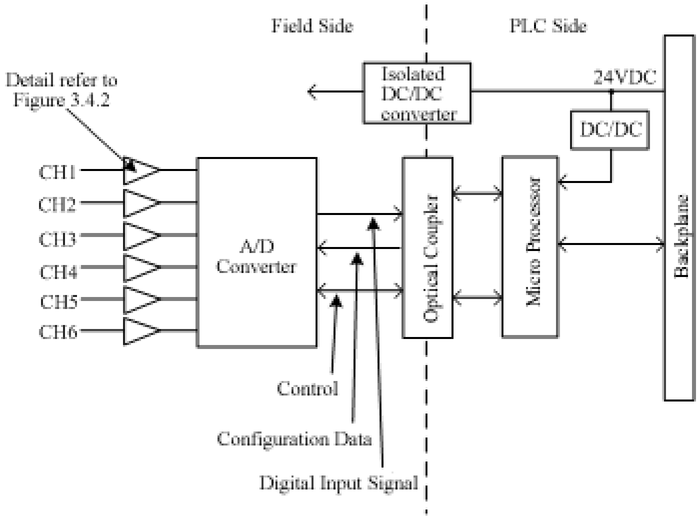


Figure 5.48: Internal Structure of LK415 Module

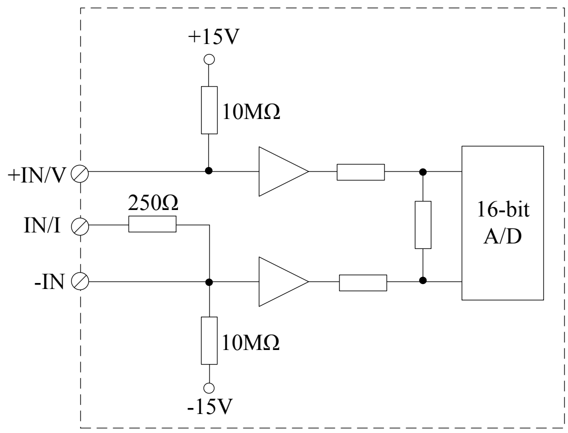


Figure 5.49: Channel Interface Circuit of LK415 Module

5.6.3 Indicators Definition

Refer to section 5.1.1: The LED Status indicator

5.6.4 Wiring Specifications

When connect to two-wire transformers, LK415 module does not supply power to external devices. Therefore, a separated 24V DC field power supply shall be adopted by each input channel to provide power to the transformer. To ensure the isolation between field and system, the field power supply shall be separated from the backplane power supply.

LK415 module can be installed on both the LK local backplanes and the expansion backplanes. The LK series backplanes support two types of wirings: terminal wiring and prefabricated cable wiring.

Wiring to Backplane Terminals

Channel Number	Terminal Number		
	Voltage Input Positive End (+IN/V)	Current Input (+IN/I)	Common Negative End
1	01	03/01	05
2	02	04/02	06
3	07	09/07	11
4	08	10/08	12
5	13	15/13	17
6	14	16/14	18

Table 5.41: Definitions of LK415 Backplane Wiring Terminals

In the wiring, the following shall be noted:

- The 18digit double wiring terminals shall be installed on the backplane, right under the installation slot of LK415 module.
- The measurement range of each channel can be configured separately, e.g. each channel can import either voltage signals or current signals.
- For current signals, Terminal 03 and Terminal 01 of Channel 1 can be short connected to be the positive end of current input, Terminal 04 and Terminal 02 of Channel 2 can be short connected to be the positive end of current input, terminal connections of other channels are similar.
- Each channel of the AI signals that come from the field is connected to its respective terminal through two (shielded) cables.
- The input channels do not supply power to the transformer; therefore a separated field 24V DC power supply will be needed when the module is connected to a two-wire transformer.
- After wiring, cable connections shall be checked to ensure the correct wiring. In order to avoid dangers such as short circuit, there shall be no nude cable outside of the terminals.

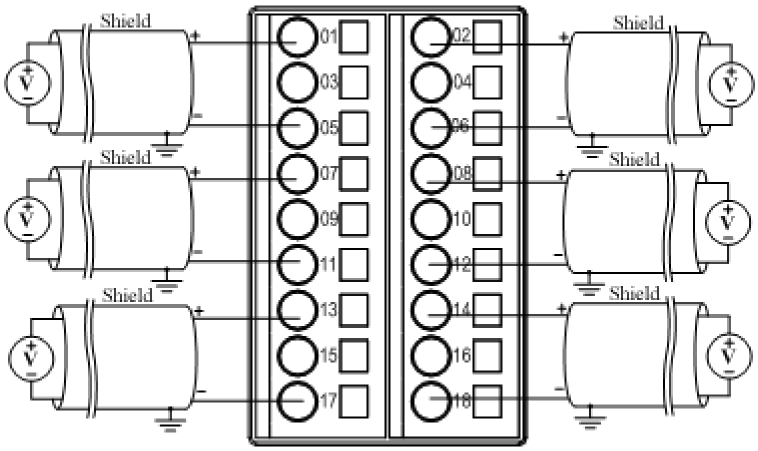


Figure 5.50: Wiring of LK415 Voltage Channel Terminals

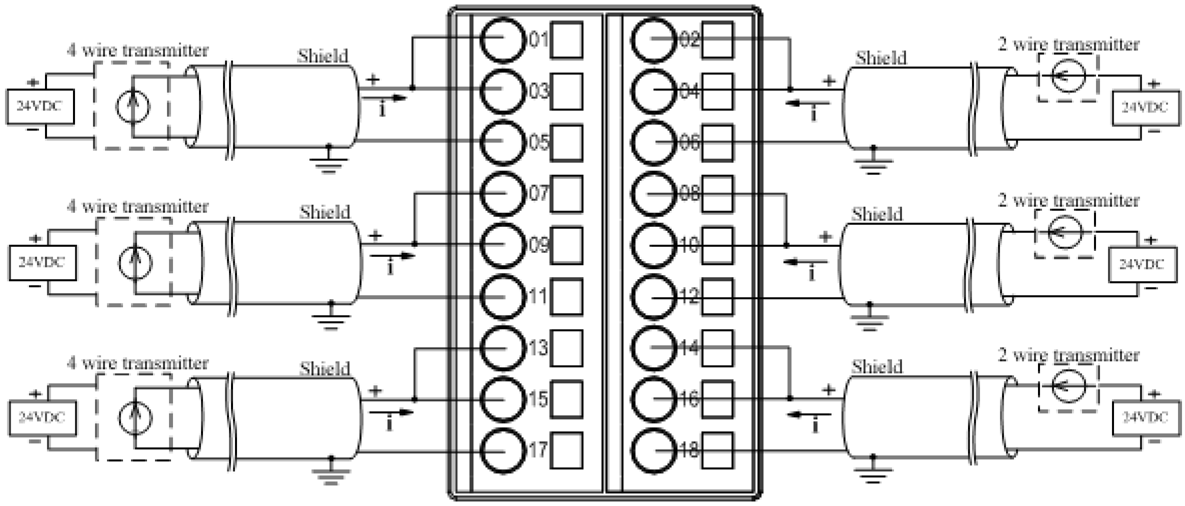


Figure 5.51: Wiring of LK415 Current Channel Terminals

Wiring to Terminal Modules

Please refer to the information found on Chapter 12: Terminal Module.

5.6.5 Function Specifications

Output Format of the Measurement Data

As shown in Table 5.42, the measurement data that reported through LK415 AI channels are represented by 2byte positive integer codes (decimal value range 0~65535). Among which, the voltage range (-10.25~+10.25V) are divided into two segments, the positive voltage (0~10.25V) signals are represented by decimal code value range 0~32767 while the negative voltage (-10.25~0) signals by decimal code value range 32768~65535.

Maximum Measurement Range		Decimal Code Value
-10.25~+10.25V	0~10.25V	0~32767
	-10.25V~0V	32768~65535
0~10.25V		0~65535
0~5.125V		0~65535
0~20.58mA		0~65535
4~20.58mA		0~65535

Table 5.42: The Corresponding Relation of LK415 Input Voltage and the Decimal Code

The measurement data of the range (-10.25~+10.25) can be converted to their corresponding codes by the following equation:

- Positive voltage 0~+10.25: Voltage Value (V) = measurement data/32767×10.25
- Negative Voltage -10.25~0V: Voltage Value (V) = (measurement data -65535)/32767×10.25

The function block HS_HEX_ENGIN in the analog conversion library HS_AnalogConvert.lib of the configuration software Powerpro V4 can be called to convert the 2 byte measurement value into engineering data. (Field side signal that being measured include pressure, temperature and voltage, etc. Once the upper and lower limit of engineer units has been defined, the function block will output the corresponding value according to the measured value automatically.)

For detailed usage of the function block, please refer to the LK Series PLC - Instruction Manual.

To set the upper and lower alarm limits of user parameters, the voltage signals shall be converted into the format of decimal machine codes. For different ranges, the machine code conversion methods are different.

- For the ranges of 0~10.25V, 0~5.125V and 0~20.58mA, the Signal conversion equation is as follow:

  *Machine Code Value = Signal×65535/Full Range Value**

  ** The Full Range Value measurement range equal to maximum measurable value minus minimum measurable value*

Take Channel 1 for example, if its measurement range is set as “0~10.25V”, the limit exceeding alarm is enabled and the user-defined upper and lower voltage limits are set as 10V and 5V, then the alarm upper limit shall be10×65535/10.25=63936 and the lower limit 5×65535/10.25=31968. The user parameter configuration is shown in Figure 5.52.

"CH1 Input Range"	0~10.25V
"CH1 Upper Limit Exceeded Alarm"	Enable
"CH1 Lower Limit Exceeded Alarm"	Enable
"CH1 Upper Limit Value"	63936
"CH1 Lower Limit Value"	31968

Figure 5.52: Example of Parameter Setting in Set Range under Programming Mode

- For the ranges of 4~20.58mA, the signal and code value conversion equation is as follow:

Code Value = (Current Signal - 4) × 65535/16.58

Take Channel 2 for example, if its measurement range is set as “4~20.58mA”, the limit exceeded alarm is enabled and the user-defined upper and lower current limits are set as 15mA and 5mA, then the alarm upper limit shall be(15-4)×65535/16.58=43479 and the lower limit (5-4)×65535/16.58=3952. The user parameter configuration is shown in Figure 5.53.

"CH1 Input Range"	4~20.58mA
"CH1 Upper Limit Exceeded Alarm"	Enable
"CH1 Lower Limit Exceeded Alarm"	Enable
"CH1 Upper Limit Value"	43479
"CH1 Lower Limit Value"	3952

Figure 5.53: Example of Parameter Setting in Set Range under Programming Mode

For the ranges of -10.25~+10.25V, the signal and code conversion equation is as follow:

Positive Voltage Range (0~10.25): Machine Code Value = Positive Voltage Signal ×32767/10.25

Negative Voltage Range (-10.25~0V): Machine Code Value = 65535 + (Negative Voltage Signal ×32767/10.25)

Take Channel 3 for example, if its measurement range is set as “-10.25~+10.25V”, the limit exceeding alarm is enabled and the user-defined upper and lower voltage limits are set as 10V and -10V, then the alarm upper limit shall be10×32767/10.25=31968 and the lower limit 65535+（-10×32767/10.25)V=33567. The user parameter configuration is shown in Figure 5.54.

"CH3 Input Range"	-10.25~10.25V
"CH3 Upper Limit Exceeded Alarm"	Enable
"CH3 Lower Limit Exceeded Alarm"	Enable
"CH3 Upper Limit Value"	31968
"CH3 Lower Limit Value"	33567

Figure 5.54: Example of Parameter Setting in Set Range under Programming Mode

5.6.6 Specifications of Diagnosis

PowerPro V4 configuration software adopts external diagnosis library to check and acquire all kinds of diagnosis information, such as whether the module and its channels are operating normally and whether the module parameters are set correctly.

For the DP slave station modules, the DP slave station expansion diagnosis function block (HS_DPSlaveALarm) shall be called to check the DP module at any address on the PROFIBUS-DP link, as shown in Figure 5.55.

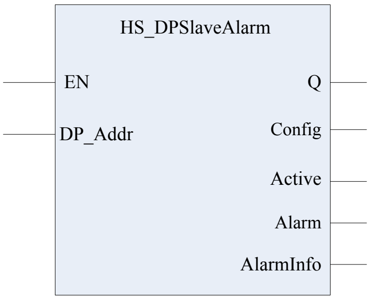


Figure 5.55: Expansion Diagnosis Function Block for DP Slave Station

For detailed usage of DP Expansion Diagnosis Function Block, please refer to LK Large Scale PLC Instruction Manual. Users shall note that the Diagnosis library is an external library that shall be first installed in the Library Manager before use.

The diagnosis information of DP slave station modules can be classified to 3 categories: device diagnosis, identifier diagnosis and channel diagnosis. All diagnosis data exist in the form of block structure.

- **Device Diagnosis:** records of the overall diagnosis information of the module, such as, power loss of field power supply.
- **Identifier Diagnosis:** records of whether the module has diagnosis information.
- **Channel Diagnosis:** records of the channel level diagnosis information, such as line-break and rang exceeding.

Channel diagnoses such as those of range exceeding, limit exceeding and line-break may be applied to LK415 signal input channels. Device diagnoses such the field power supply failure checking can be applied on the power supply channel. After the DP slave station expansion diagnosis function block (HS_DPSlaveAlarm) is called, the channel diagnosis and device diagnosis data reported by LK415 will be stored in the corresponding fields of the output parameter "AlarmInfo", as shown in Table 5.43.

Diagnosis Information		Value	Definition
Channel Diagnosis	ChDiag.Module.Channel.ChNo	1~8	Channel Number of the Failure
	ChDiag.Module.Channel.Error	2	Short of Range
		3	Over Range
		6	Line-Break
		7	Upper Limit Exceeded
		8	Lower Limit Exceeded
		0	Channel Failure Recovered

Table 5.43: Definition of LK415 Diagnosis Information

Measurement Range Exceeded Alarm

LK415 module provides the function of Measurement Range Exceeded Alarm. When the input signals exceed the preset measurement range, Channel Diagnosis will report "Over Range", when the signal fell back into range again, it will report "Failure Recovered".

LK415 module will only report the diagnosis data once respectively when signals exceeded range and when the failure is recovered.

Special attention shall be taken that for LK415 module, the valid range is not the maximum measurement range. Therefore, the input signals may still be within the maximum range when they exceed the valid range.

When the input signal exceeds valid range but are still within the maximum measurement range, the channel will report the code value of the current signal as the measured data; when the signal is higher than the maximum measurable range, the code value of the maximum measurable signal will be reported as the measured data; when the signal is lower than the minimum measurable range, the channel will report the code value of the minimum measurable signal.

Measurement Range	Range Exceeding	
	Over Range	Short of Range
0~20mA	>20mA	<0mA
4~20mA	>20mA	<4mA
-10V~10V	>10V	<-10V
0~10V	>10V	<0V
0~5V	>5V	<0V

Table 5.44: LK415 Definition of Range Exceeding

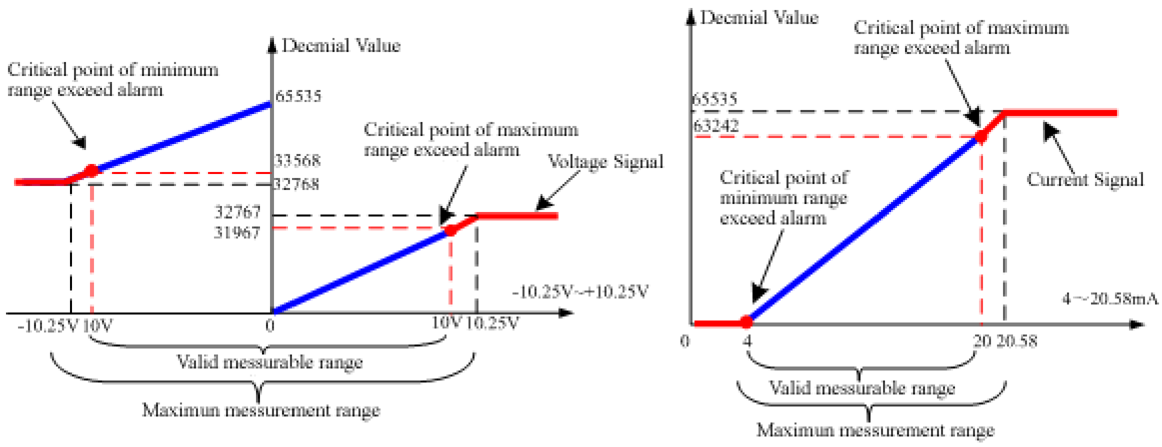


Figure 5.56: Range Exceeded Alarm Diagnosis of LK415

As for different ranges set by users, the module provides different diagnosis processes of rang exceeding, as shown in Table 5.45. When signals fall back into the normal range, the channel will report diagnosis byte 0x00.

Maximum Measurement Range	Measurement Range	Range Exceeding	Process of Range Exceeding
0~20.58mA	0~20mA	Over Range	Channel report diagnosis byte 0x03 20~20.58mA, channel reports the code values 63688~65535 of the measured data >20.58mA, channel reports 65535
		Short of Range	Channel report diagnosis byte 0x02 Channel reports 0 as measurement data
4~20.58mA	4~20mA	Over Range	Channel report diagnosis byte 0x03 20~20.58mA, channel reports the code values 63242~65535 of the measured data >20.58mA, channel reports 65535
		Short of Range	Channel report diagnosis byte 0x02 Channel reports 0 as measurement data
-10.25V~10.25V	-10V~10V	Over Range	Channel report diagnosis byte 0x03 10~10.25V, Channel reports the code value 31967~32767 of the measured data >10.25V, channel reports 32767
		Short of Range	Channel report diagnosis byte 0x02 -10.25~-10V, Channel reports the code value 32767~33568 of the measured data <-10.25V, channel reports 32768
0~10.25V	0~10V	Over Range	Channel report diagnosis byte 0x03 10~10.25V, channel reports the code values 63937~65535 of the measured data >10.25V, channel reports 65535
		Short of Range	Channel report diagnosis byte 0x02 Channel reports 0 as measurement data
0~5.125V	0~5V	Over Range	Channel report diagnosis byte 0x03 5~5.125V, channel reports the code values 63937~65535 of the measured data

			>5.125V, channel reports 65535
		Short of Range	Channel report diagnosis byte 0x02 Channel reports 0 as measurement data

Table 5.45: LK415 Processes of Rang Exceeded Alarm in Different Ranges

Limit Exceeded Alarm

LK415 module provides the function of Limits Exceeding Alarm. When input signals exceed the configured range, e.g. when they are higher than the upper alarm limit or lower than the lower limit, the channel will report diagnosis byte "exceed limits". When input signals fall back into the configured range, the channel will report "failure recovered".

LK415 module will only report the diagnosis data once respectively when signal exceeds limits and when the failure is recovered.

The upper alarm current limit shall be higher than the lower limit, otherwise LK415 module will not be able to correctly report diagnosis information. If the limit exceeded alarm is enabled, and the limit exceeding and range exceeding occur at the same time, LK414 will only report the exceeding of range.

Measurement Range	Setting of Alarm Value
0~20mA	20mA>Current Upper Limit>Current Lower Limit>0mA
4~20mA	20mA>Current Upper Limit>Current Lower Limit>4mA
-10V~10V	10V>Upper Limit Voltage>Lower Limit Voltage>-10V
0~10V	10V>Upper Limit Voltage>Lower Limit Voltage>0V
0~5V	5V>Upper Limit Voltage>Lower Limit Voltage>0V

Table 5.46: Value Range of LK415 Alarm Limits

Represented by two bytes of positive integer codes, The alarm value in the configuration is the machine code value of those measured signal within the set Measurement Range. The value range of the upper alarm limit is 1~65535 and the default value is 32767. The value range of the lower alarm limit is 0~65534 and the default value is 0. Their calculation equations are as shown in Table 5.47.

Measurement Range		Upper Alarm Limit Code (Decimal)	Lower Alarm Limit Code (Decimal)
0~20.58mA		Upper Limit Current×65535/20.58	Lower Limit Current×65535/20.58
4~20.58mA		(Upper Limit Current-4)×65535/16.58	(Lower Limit Current-4)×65535/16.58
±10.25V	-10.25-0V	65535 + (Lower Limit Voltage×32767/10.25)	65535 + (Lower Limit Voltage×32767/10.25)
	0~10.25V	Upper Limit Voltage×32767/10.25	Lower Limit Voltage×32767/10.25
0~10.25V		Upper Limit Voltage×65535/10.25	Lower Limit Voltage×65535/10.25
0~5.125V		Upper Limit Voltage×65535/5.125	Lower Limit Voltage×65535/5.125

Table 5.47: Calculation of LK415 Alarm Limit Value Codes

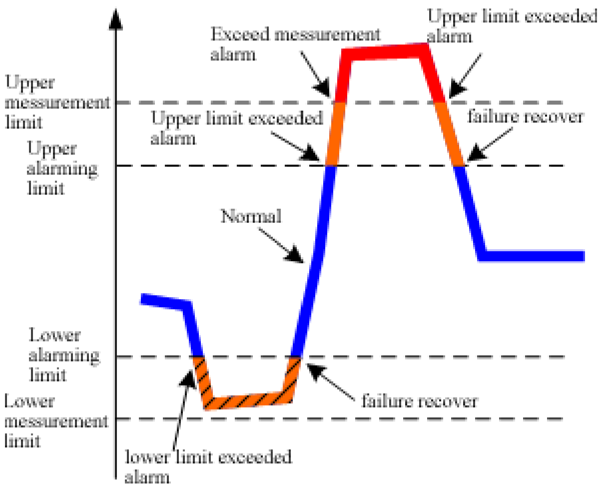


Figure 5.57: Limit Exceeded Alarm Diagnosis of LK415

In case the input signals of one channel exceed limit:

- When signals exceed the upper limit, the channel reports diagnosis byte 0x07

- When signals exceed the lower limit, the channel reports diagnosis byte 0x08
- The channel reports the code value of the currently measured signal.
- When signals fall back into the normal range, the channel reports diagnosis byte 0x00.
- The lower limit exceeded alarm function is enabled by the configuration of parameter "CH1~CH6 Lower Limit Exceeded Alarm" while the upper limit exceeded alarm function is enabled by the configuration of parameter "CH1~CH6 Upper Limit Exceeded Alarm". The default configuration of both is "disabled". When the alarm functions are enabled, the lower and upper alarm limits can be set through parameters "CH1~CH6 Lower Limit value" and "CH1~CH6 Upper Limit Value".
- The limit exceeded alarm function, upper and lower alarm limits of the 6 channels are configured separately.

"CH1 Upper Limit Exceeded Alarm"	Disable	6 channel Lower/Upper limit exceeded alarm
"CH1 Lower Limit Exceeded Alarm"	Disable	
"CH2 Upper Limit Exceeded Alarm"	Disable	
"CH2 Lower Limit Exceeded Alarm"	Disable	
"CH3 Upper Limit Exceeded Alarm"	Disable	
"CH3 Lower Limit Exceeded Alarm"	Disable	
"CH4 Upper Limit Exceeded Alarm"	Disable	
"CH4 Lower Limit Exceeded Alarm"	Disable	
"CH5 Upper Limit Exceeded Alarm"	Disable	
"CH5 Lower Limit Exceeded Alarm"	Disable	
"CH6 Upper Limit Exceeded Alarm"	Disable	
"CH6 Lower Limit Exceeded Alarm"	Disable	
"CH1 Upper Limit Value"	32767	6 channel Lower/Upper limit value
"CH1 Lower Limit Value"	0	
"CH2 Upper Limit Value"	32767	
"CH2 Lower Limit Value"	0	
"CH3 Upper Limit Value"	32767	
"CH3 Lower Limit Value"	0	
"CH4 Upper Limit Value"	32767	
"CH4 Lower Limit Value"	0	
"CH5 Upper Limit Value"	32767	
"CH5 Lower Limit Value"	0	
"CH6 Upper Limit Value"	32767	
"CH6 Lower Limit Value"	0	

Figure 5.58: Limit Exceeded Alarm Parameters of LK415

Detection of Line-break

LK415 module provides line-break detection function.

As shown in Figure 5.59, a 10MΩ pull-up resistor is connected to the signal channel. LK415 detects line-break by checking changes of the input voltage between two wiring terminals. In case of any failure, the failure status will be reported to the controller as the diagnosis data. When there is line-break in an input channel, the positive-end voltage of the channel will be pulled up to +15V and the negative-end voltage will be pulled down to -15V, then the voltage difference on the input-end of AD transfer will reach the maximum value, the channel will report "Line-break". After the channel is reconnected, it will report "Failure Recovered".

LK415 module will only report the diagnosis data once respectively when line-break occurs and when the failure is recovered. The line-break alarm can be enabled through configuration software. By default, it is set as disabled. If a input channel is not wired, it will be considered as disconnected. Therefore, for the channels not in use, it is suggested to disable the Line-break Alarm function, e.g. to keep the default value of parameter "Line Break Alarm".

When line-break occurred in a channel, the module provides different diagnosis processes for different ranges set by users, as shown in Table 5.48. When the connection is recovered, the channel will report diagnosis byte 0x00

Signal Type	Line-break	Processes of Line-break
Current Signal	Line-break of short connected cable (+IN/V)	CChannel reports diagnosis byte of failure value 0x06 CChannel reports 65535 as measurement data
	Line-break of field signal cable (+IN/I, -IN)	CChannel reports diagnosis byte of line-break value 0x06 CChannel reports 0 as measurement data
Voltage Signal	Line-break of field signal cable (+IN/V, -IN)	Channel reports diagnosis byte of line-break value 0x06 Channel reports 65535 or 32767 (-10.25~10.25V Range) as the measurement data

Table 5.48: LK415 Processes of Line-break for Different Signal Types

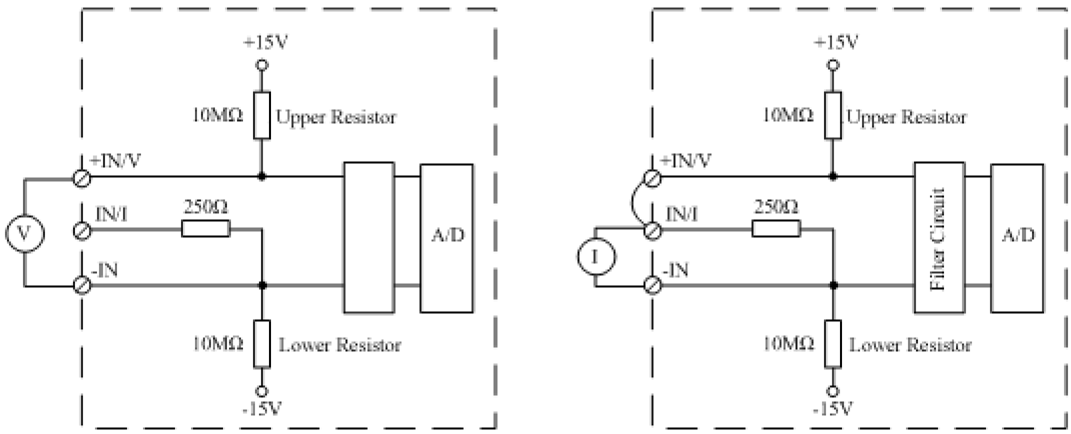


Figure 5.59: LK415 Detection Circuit of Channel Line-break

5.6.7 Parameter Specifications

The controller can only read and write the I/O information regularly after it entered data exchange mode. Therefore, in order to provide correct parameter information in the initialization process, users shall first set the parameters in the configuration software.

Communication Parameters

Supporting PROFIBUS-DP slave station protocol, LK415 completes data exchanges and diagnosis information reporting with the controller and other DP master stations. The slave station adopts a unique communication address, which is determined by the backplane number and the slot number of the LK415 module. The slave station address shall be correctly filled in the DP parameter field in the configuration software, as shown in Figure 5.60. Other communication parameters shall keep their default values.

Please also refer to Chapter 2: Backplanes for the calculation of station number.

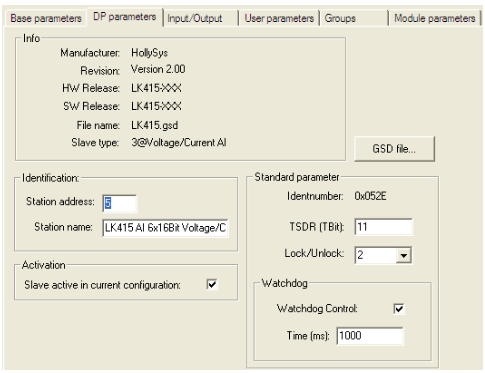


Figure 5.60: Setting of LK415 Communication Parameters

User Parameters

User parameters are used to configure the module's operating mode. They are written into the controller during the download of user program and will not be read in every scanning circle. Each parameter has a default value that can be changed according to requirements of the project. User parameters do not support online modification, therefore they can only be effective after the full download.

LK415 module has totally 36 bytes of user parameters.

Parameter Name	Parameter Definition	Parameter Value
Filter Mode	Parameter of Digital Filter Mode Selection	0=No Filter, no filter operation 1=10Hz Filter, filter of 10Hz interference 2=50Hz Filter, filter of 50Hz interference (default value) 3=60Hz Filter, filter of 60Hz interference 4=400Hz Filter, filter of 400Hz interference

Sample Rate	Sample Rate Selection	0: Fast, the fastest sample rate; 1: Normal (Default value, drift control function enabled, but the internal sample time doubled)
CH1 Input Range	Range Selection of Channel 1 (The setting of "Range Selection" for individual channel would not affect others. It is allowed to have different "Range Selection" setting for different channels.)	16=-10.25~10.25V (Default); 17=0~10.25V; 18=0~5.125V; 70=0~20.58mA 71=4~20.58mA
CH2 Input Range	Range Selection of Channel 2	
CH3 Input Range	Range Selection of Channel 3	
CH4 Input Range	Range Selection of Channel 4	
CH5 Input Range	Range Selection of Channel 5	
CH6 Input Range	Range Selection of Channel 6	
CH1 Digital Filter	Software Filter Selection of Channel 1 (The setting of "Software filter Selection" for individual channel would not affect others. It is allowed to have different "Software filter Selection" setting for different channels.)	0=None, no software filter (default value) 1=4Points, select 4 latest history points 2=8Points, select 8 latest history points 3=16Points, select 16 latest history points
CH2 Digital Filter	Software Filter Selection of Channel 2	
CH3 Digital Filter	Software Filter Selection of Channel 3	
CH4 Digital Filter	Software Filter Selection of Channel 4	
CH5 Digital Filter	Software Filter Selection of Channel 5	
CH6 Digital Filter	Software Filter Selection of Channel 6	
CH1 Upper Limit Exceeded Alarm	Enable the Upper Limit Exceeded Alarm of Channel 1	0=Disable, the alarm is disabled (default); 1= Enable, the alarm is enabled.
CH1 Lower Limit Exceeded Alarm	Enable the Lower Limit Exceeded Alarm of Channel 1	
CH2 Upper Limit Exceeded Alarm	Enable the Upper Limit Exceeded Alarm of Channel 2	
CH2 Lower Limit Exceeded Alarm	Enable the Lower Limit Exceeded Alarm of Channel 2	
CH3 Upper Limit Exceeded Alarm	Enable the Upper Limit Exceeded Alarm of Channel 3	
CH3 Lower Limit Exceeded Alarm	Enable the Lower Limit Exceeded Alarm of Channel 3	
CH4 Upper Limit Exceeded Alarm	Enable the Upper Limit Exceeded Alarm of Channel 4	
CH4 Lower Limit Exceeded Alarm	Enable the Lower Limit Exceeded Alarm of Channel 4	
CH5 Upper Limit Exceeded Alarm	Enable the Upper Limit Exceeded Alarm of Channel 5	
CH5 Lower Limit Exceeded Alarm	Enable the Lower Limit Exceeded Alarm of Channel 5	
CH6 Upper Limit Exceeded Alarm	Enable the Upper Limit Exceeded Alarm of Channel 6	
CH6 Lower Limit Exceeded Alarm	Enable the Lower Limit Exceeded Alarm of Channel 6	
CH1 Upper Limit Value	Setting the Alarm Upper Limit Value of Channel 1	Alarm Lower Limit Range: 0~65534 Alarm Upper Limit Range: 1~65535 Alarm Default Lower Limit: 0 Alarm Default Upper Limit: 32767
CH1 Lower Limit Value	Setting the Alarm Lower Limit Value of Channel 1	
CH2 Upper Limit Value	Setting the Alarm Upper Limit Value of Channel 2	
CH2 Lower Limit Value	Setting the Alarm Lower Limit Value of Channel 2	
CH3 Upper Limit Value	Setting the Alarm Upper Limit Value of Channel 3	
CH3 Lower Limit Value	Setting the Alarm Lower Limit Value of Channel 3	
CH4 Upper Limit Value	Setting the Alarm Upper Limit Value of Channel 4	
CH4 Lower Limit Value	Setting the Alarm Lower Limit Value of Channel 4	
CH5 Upper Limit Value	Setting the Alarm Upper Limit Value of Channel 5	
CH5 Lower Limit Value	Setting the Alarm Lower Limit Value of Channel 5	
CH6 Upper Limit Value	Setting the Alarm Upper Limit Value of Channel 6	
CH6 Lower Limit Value	Setting the Alarm Lower Limit Value of Channel 6	
CH1 Line Break Alarm	Enabled the Line-break Alarm of Channel 1	0=Disable, the alarm is disabled; 1= Enable, the alarm is enabled.
CH2 Line Break Alarm	Enabled the Line-break Alarm of Channel 2	
CH3 Line Break Alarm	Enabled the Line-break Alarm of Channel 3	
CH4 Line Break Alarm	Enabled the Line-break Alarm of Channel 4	
CH5 Line Break Alarm	Enabled the Line-break Alarm of Channel 5	
CH6 Line Break Alarm	Enabled the Line-break Alarm of Channel 6	

Table 5.49: List of LK415 User Parameters

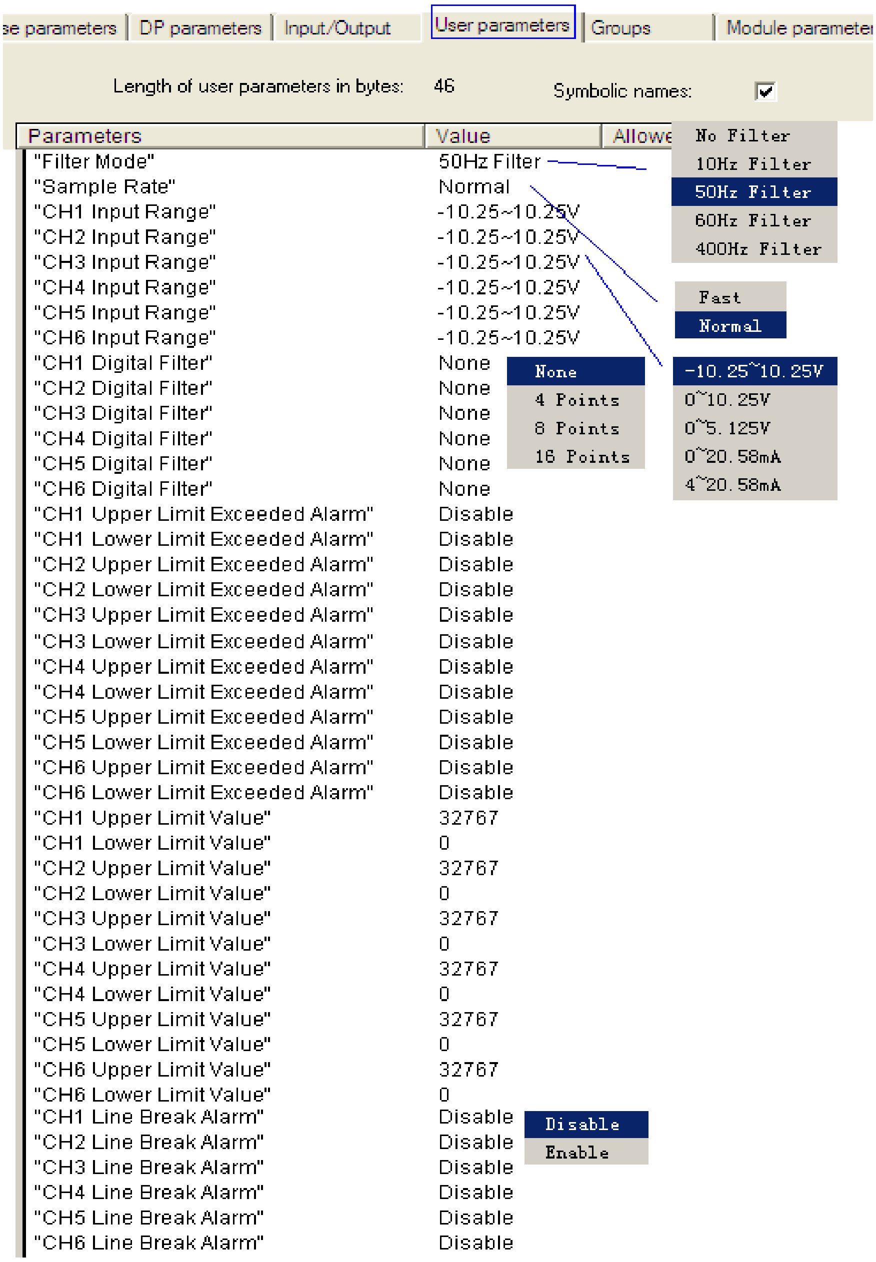


Figure 5.61: Setting of LK415 User Parameters

5.6.8 Module Installation and Un-installation

Refer to chapter 1 on "Module Insertion Mechanical keys" and "Module Insertion and Removable" for more details.

5.6.9 Technical Specification

LK415 [6-channel AI module]					
Power Supply					
Input Voltage		24VDC(-15%~+20%)			
Power Consumption		100mA@24VDC			
Input Channel					
Channel number		6			
Range Code		16		17	18
Maximum Measurement Range	Voltage Signal	-10.25~0V	0~10.25V	0~10.25V	0~5.125V
	Data Format	32768~65535	0~32767	0~65535	0~65535
Range Code		70		71	
Maximum Measurement Range	Current Signal	0~20.58mA		4~20.58mA	
	Data Format	0~65535		0~65535	
Input Impedance	Voltage Signal	>1MΩ			
	Current Signal	250Ω			
ADC resolution		16 bits			
Sample Period (without software filter)	Hardware Filtering of 50Hz Interference	Default Sample Rate		360ms/6channel	
		Fastest Sample Rate		180ms/6channel	
	Hardware Filtering of 60Hz Interference	Default Sample Rate		300ms/6channel	
		Fastest Sample Rate		150ms/6channel	
Differential Mode Suppression Rate		80dB			
Integral Mode Suppression Rate		100dB			
Calibration Precision (25ºC)		0.03%F.S.			
Measurement Precision		0.1%F.S.			
Step Response Time		Less than 1 second to reach 90% of target value			
Temperature Drift		±25ppm/ºC			
Failure Diagnosis and Hot swap					
Measurement Range Exceeded Alarm		Signal exceed Range upper/lower boundaries, diagnosis byte reports 0x03/0x02			
Limit Exceeded Alarm		Signal exceed Alarm upper/lower limits, diagnosis byte reports 0x07/0x08			
Detection of Line-break		Line-break, channel reports diagnosis byte 0x06. Connection recovered, channel reports 0x00			
Hot swap		Support			
Isolation Voltage					
Channel to System		500V AC 1min Testing, Current Leak 5mA			
Communication					
protocol		PROFIBUS-DP Slave Station, in accordance with IEC61158-3/EN50170 standards			
Baud Rate		1.5Mbps, 500Kbps, 7.5Kbps, 93.75Kbps, 45.45Kbps, 31.25Kbps, 19.2Kbps, 9.6Kbps			
Media		Communication bus is connected to the backplane through euro connector, hot redundant communication media			
Physical Features					
Mechanic Keys to Prevent Incorrect Insertion		A0			
Installation		Installation on backplane sockets			
Installation Location		LK local backplane or expansion backplane			
Dimension		Width × Height × Depth = 35mm×100mm×100mm			
Casing Protection Level		IEC60529 IP20			
Weight		190g			
Working Environment					
Working Temperature		0ºC~60ºC			
Working Relative Humidity		5%~95%, no condensate			
Storage Temperature		-40ºC~70ºC			
Storage relative Humidity		5%~95%, no condensate			

Table 5.50: Technical Specification of LK415 Module

5.7 LK430 [6 CHANNEL RTD AI MODULE]

5.7.1 Features

- 6 channels of RTD inputs, constant-current source
- RTD types: Copper427, Chinese_Cu, Nikel 618, Nikel 672, Platinum385, Platinum3916
- Resistance Range: 1~4020Ω
- Detection of Line-break
- Calibration on Field
- Support ProfiBus-DP slave station protocol
- RTD inputs may report temperature or resistance value
- Upper Limit Exceeded Alarm
- Lower Limit Exceeded Alarm
- System-to-Field Isolation
- Supports hot swap

5.7.2 Operation Principles

The 24V DC system power supply of LK 430 module goes through the isolated DC/DC converter to output a 5VDC power supply for the interface circuit. This interface circuit is connected to other circuits through optical couplers to enable the isolation between the field circuit and the system.

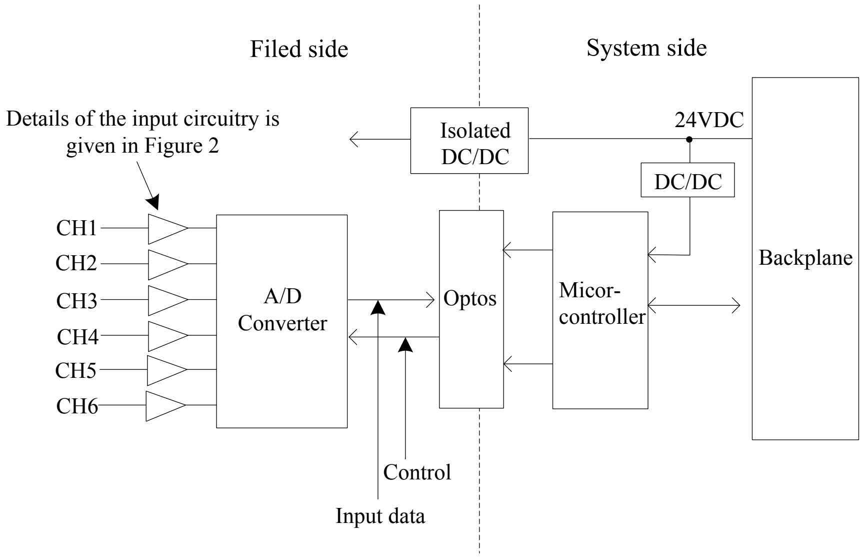


Figure 5.62: Internal Structure of LK430 Module

LK430 adopts constant-current source measurement methods to input signals from the 3-wire RTD. In spite of the basic requirement that the three conductive cables of RTD must have the same line resistances, this measurement method can more efficiently remove the influence of line resistance on measurement accuracy in case of non-balanced electric-bridge than the traditional electric-bridge measurement method. The interface circuit is shown in Figure 5.63.

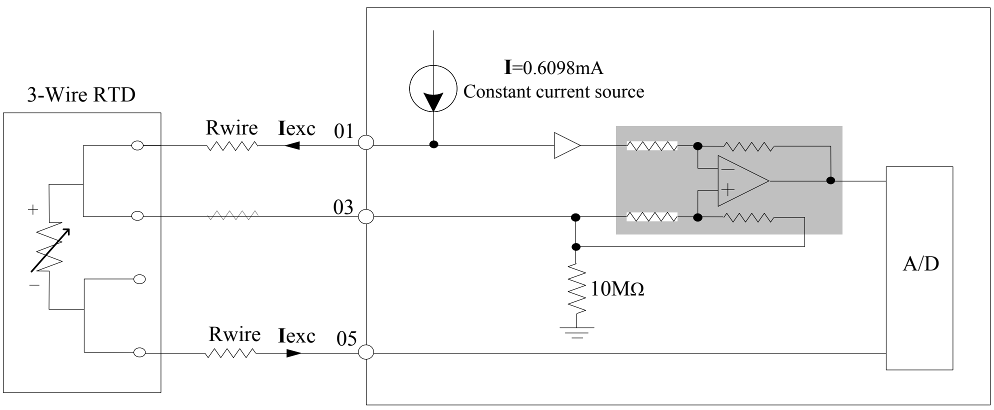


Figure 5.63: LK430 Channel Interface Circuit (Taking Channel1 as Example)

5.7.3 Indicators Definition

Refer to section 5.1.1: The LED Status indicator

5.7.4 Wiring Specifications

Wiring to Terminal Modules

Please refer to the information found on Chapter 12: Terminal Module.

Wiring to Backplane Terminals

Channel Number	Terminal Number		
1	01	03	05
2	02	04	06
3	07	09	11
4	08	10	12
5	13	15	17
6	14	16	18

Table 5.51: Definitions of LK430 Backplane Wiring Terminals

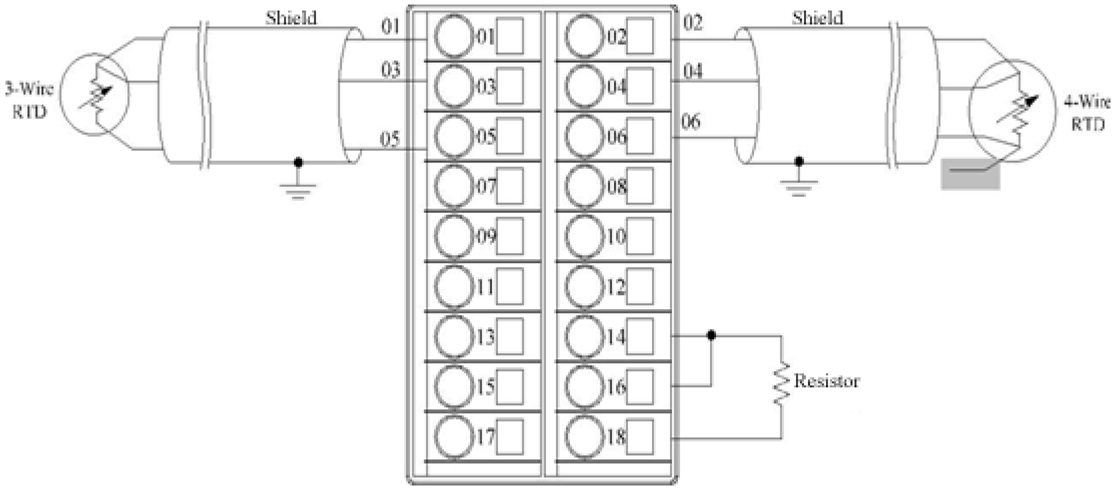


Figure 5.64: Wiring of LK430 Backplane Terminals

In the wiring, the following shall be noted:

- The 18digit double wiring terminals shall be installed on the backplane, right under the installation slot of LK430 module.
- Every RTD is connected to its respective terminal through three wires (shielded cables).
- A single terminal shall not be connected to many wires; therefore multiple-point connection can be established through bus bar or transferring terminal board.

5.7.5 Function Specifications

Output Format of the Measurement Data

Represented by 2byte positive integer codes, the measurement data reported by each LK410 channel have two configurable output format options: output resistance value codes or output temperature value codes. The conversion equation between measurement data and engineering value:

In case the module is configured to output resistance value, then: resistance value (Ω) = (resistance code/65535)×full-range resistance value + the minimum measurable resistance value within range; among which, the full-range resistance value equals the maximum measurable resistance value minus the minimum value within the range. For example, as shown in Table 5.52, the maximum measurable resistance range of Cu50 is 1~121.75Ω, so the full-range resistance value = 121.75-1=120.75.

In case the module is configured to output temperature value, then: Temperature Value (Celsius or Fahrenheit) = (Temperature Code-10000) /10. The output format of measurement data can be configured by parameter "DataFormat", the default value is temperature code. Through simple conversion calculation in programming software PowerPro V4, users can get the actual temperature or resistance values of the field.

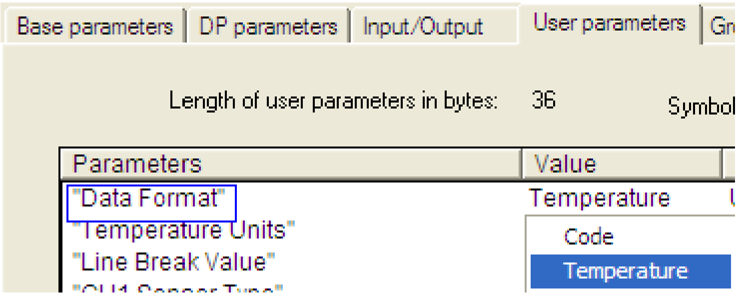


Figure 5.65: LK430 Output Data Format Selection

Measurement Range

All standard RTDs and their measurement ranges that are applicable to LK430 are shown in Table 5.52.

RTD type	Temperature Range of RTD （ºC）	Resistance Range of RTD (Ω)	Range Code	Maximum Measurable Resistance Range (Ω)
Copper427 10Ω	-200ºC~260ºC	3.69980~21.1574	192	1~121.75
Chinese_Cu 50Ω	-50ºC~150ºC	39.243~82.136	193	
Nikel618 100Ω	-60ºC~250ºC	69.5204~343.584	194	1~487
Nikel618 120Ω	-60ºC~250ºC	83.4245~412.301	195	
Platinum385 100Ω	-200ºC~870ºC	18.5201~396.311	196	
Platinum3916 100Ω	-200ºC~630ºC	16.9960~327.744	197	
Nikel618 200Ω	-60ºC~250ºC	139.041~687.168	198	2~1000
Nikel672 120Ω	-80ºC~320ºC	66.6000~568.407	199	
Platinum385 200Ω	-200ºC~870ºC	37.0402~792.622	200	
Platinum3916 200Ω	-200ºC~630ºC	33.992~655.488	201	
Nikel618 500Ω	-60ºC~250ºC	347.602~1717.92	202	4~2000
Platnium385 500Ω	-200ºC~870ºC	92.6005~1981.56	203	
Platnium3916 500Ω	-200ºC~630ºC	84.98~1638.72	204	
Platnium385 1000Ω	-200ºC~870ºC	185.201~3963.11	205	8~4020
Platnium3916 1000Ω	-200ºC~630ºC	169.960~3277.44	206	

Table 5.52: List of Standard RTDs and Measurement Ranges of LK430

Note: for the usage of a special type of resistance that is not listed in the table above, the output format of the measurement data shall be configured as resistance value. And a similar range of the stand RTDs in the above table shall be selected as the substitutive range of the special resistance. For example: to measure a 350Ω resistance, one of the ranges of Ni618 100Ω, Ni618 120Ω, Pt385 100Ω or Pt3916 100Ω shall be selected as the substitutive range.

In China, the most commonly used RTDs are Platnum385 100Ω and Chinese_Cu 50Ω of the above list, which are short-named as Pt100 and Cu50.

5.7.6 Specifications of Diagnosis

PowerPro V4 configuration software adopts external diagnosis library for all kinds of diagnosis functions, such as whether the module and its channels are operating normally and whether the module parameters are set correctly.

For the DP slave station modules, the DP slave station expansion diagnosis function block (HS_DPSlaveALarm) shall be called to check the DP module at any address on the PROFIBUS-DP link, as shown in Figure 5.66.

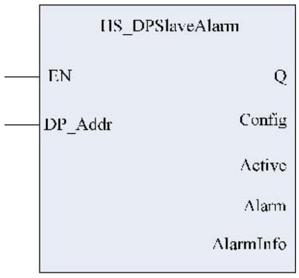


Figure 5.66: Expansion Diagnosis Function Block for DP Slave Station

For detailed usage of DP Expansion Diagnosis Function Block, please refer to LK Large Scale PLC Instruction Manual. Users shall note that the Diagnosis library is an external library that shall be first installed in the Library Manager before use.

The diagnosis information of DP slave station modules can be classified to 3 categories: device diagnosis, identifier diagnosis and channel diagnosis. All diagnosis data exist in the form of block structure.

Device Diagnosis: records of the overall diagnosis information of the module, such as, power loss of field power supply.

Identifier Diagnosis: records of whether the module has diagnosis information.

Channel Diagnosis: records of the channel level diagnosis information, such as line-break and rang exceeding.

Channel diagnoses such as those of range exceeding, limit exceeding and line-break may be applied to LK430 module. After the DP slave station expansion diagnosis function block (HS_DPSlaveAlarm) is called, the channel diagnosis data reported by LK430 will be stored in the corresponding fields of the output parameter “AlarmInfo”, as shown in Table 5.53.

Diagnosis Information		Value	Definition
Channel Diagnosis	ChDiag.Module.Channel.ChNo	1~16	Channel Number of the Failure
	ChDiag.Module.Channel.Error	6	Line-Break
		7	Upper Limit Exceeded
		8	Lower Limit Exceeded
		0	Channel Failure Recovered

Table 5.53: Definition of LK430 Channel Diagnosis Information

Limit Exceeded Alarm

LK430 module provides the function of Limits Exceeded Alarm. Users can configure the upper and lower alarm limits of input signals within the set measurement range. When input signals exceed the configured range, e.g. when they are higher than the upper alarm limit or lower than the lower limit, the channel will report diagnosis byte “exceed limits”. When input signals fall back into the configured range, the channel will report “failure recovered”.

For all standard types RTDs (as shown in Table 5.52) that are measurable by LK430, the module provides function of limit exceeded alarm; for other special, non-standard RTDs or resistances, LK 430 does not provide this function.

For standard RTDs, no matter the output data format is set as temperature value of resistance value, the upper and lower limits of the alarm shall be set as the positive integer codes that representing temperature values in the configuration. The calculation equations of these temperature codes of upper and lower limits are as follows:

Alarm Upper Limit Code = Alarm Upper Limit Temperature Value×10+10000

Alarm Lower Limit Code = Alarm Lower Limit Temperature Value×10+10000

The temperature units (Celsius or Fahrenheit) of the alarm upper and lower limits must be consistent with those adopted by the module, which can be configured by parameter “Temperature Units" with a default value of Celsius.

Range of Alarm Upper and Lower Limits: 6720~25908, where the upper alarm limit shall be higher than the lower limit, otherwise LK430 module will not be able to correctly report diagnosis information.

LK430 module will only report the diagnosis data once respectively when signal exceeds limits and when the failure is recovered. The limit exceeded alarm function of LK430 module; the upper and lower limits of each channel are all configurable through the software.

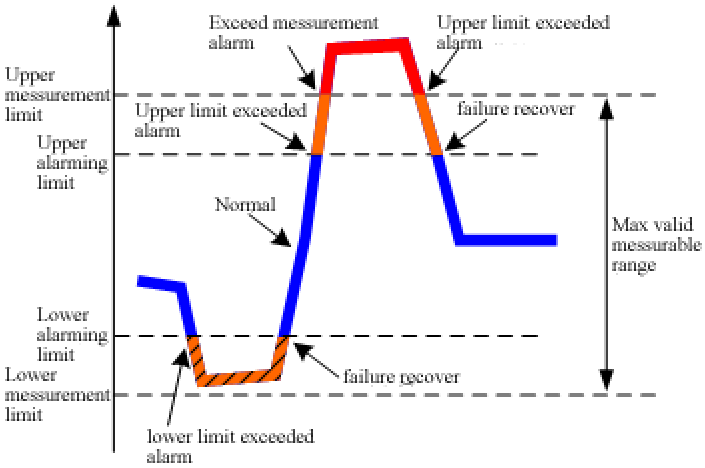


Figure 5.67: Limit Exceeded Alarm of LK430

For different configuration of LK430 measurement data format, the processes of limit exceeded diagnosis are different, as shown in Table 5.54. When signals fall back into the normal range, the channel will report diagnosis byte 0x00.

Measurement Data Format	Limit Exceeding	Process of Limit Exceeded Alarm
Temperature Value Output	Upper Limit Exceeded	1. Channel diagnosis reports failure value 0x08 2. ≤Range upper limit, channel reports the current temperature value codes as the measurement data 3. >Range upper limit, channel reports the maximum measurable temperature value codes within the range as the measurement data
	Lower Limit Exceeded	1. Channel diagnosis reports failure value 0x07 2. ≥Range lower limit, channel reports the current temperature value codes as the measurement data 3. <Range lower limit, channel reports the minimum measurable temperature value codes within the range as the measurement data
Resistance Value Output	Upper Limit Exceeded	1. Channel diagnosis reports failure value 0x08 2. ≤Range upper limit, channel reports the current resistance value codes as the measurement data 3. >Range upper limit, channel reports 0xFFFF
	Lower Limit Exceeded	1. Channel diagnosis reports failure value 0x07 2. ≥Range lower limit, channel reports the current resistance value codes as the measurement data 3. <Range lower limit, channel reports 0x0000

Table 5.54: LK430 Processes of Limit Exceeded Alarms

Detection of Line-break

LK430 module provides line-break detection function that sends line-break alarm to the controller in case any signal cable disconnected from the input channels.

When there is line-break of a channel:

- Channel diagnosis reports failure value 0x06.
- Channel measurement data report the set value of configuration. For different data formats, channel reports different measurement data in the line-break, as shown in Table 5.55.
- When the connection is recovered, the channel diagnosis reports 0x00

- LK430 module will only report the diagnosis data once respectively when line-break occurs and when the failure is recovered.

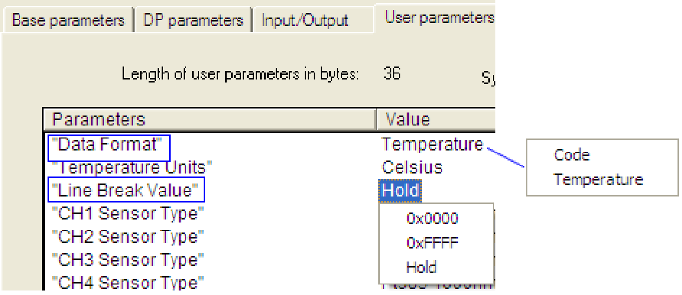


Figure 5.68: Parameters

User Parameters		Specifications of Measurement Data
Data Format	Line Break Value	
Code	0×0000	CChannel reports 0×0000 as measurement data
	0×FFFF	CChannel reports 0×FFFF as measurement data
	Hold (Default)	Channel reports the normal data before the line breakage
Temperature	0×0000	Take Channel 1 as an example, Terminal 1, 3 and 5: Line-break of Terminal 1 or/and Terminal 3, channel reports the minimum temperature code value within the range Line-break of Terminal 5, channel report the maximum temperature code value within the range
	0×FFFF	Take Channel 1 as an example, Terminal 1, 3 and 5: Line-break of Terminal 1 or/and Terminal 3, channel reports the minimum temperature code value within the range Line-break of Terminal 5, channel report the maximum temperature code value within the range
	Hold (Default)	Channel reports the normal data before the line breakage

Table 5.55: Specifications of Channel Reported Data in Line-break

5.7.7 Parameter Specifications

Communication Parameters

Supporting PROFIBUS-DP slave station protocol, LK430 completes data exchanges and diagnosis information reporting with the controller and other DP master stations. The slave station adopts a unique communication address, which is determined by the backplane number and the slot number of the LK430 module.

To establish the communication with the controller, the correct communication address of the slave station shall be filled in the LK430 module DP parameter field in the configuration software. Other communication parameters shall keep their default values.

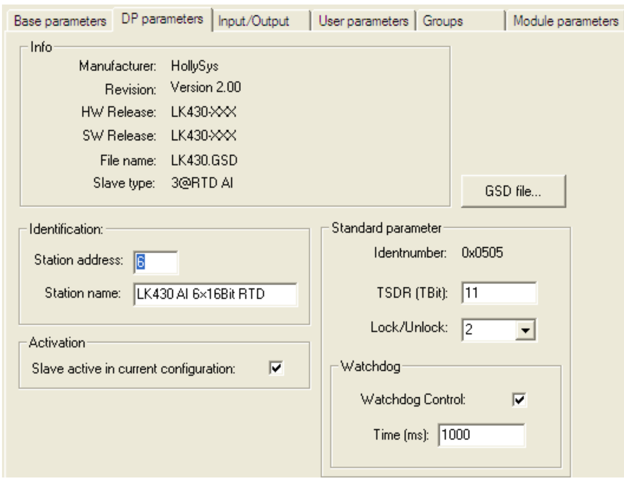


Figure 5.69: Setting of LK430 Communication Parameters

User Parameters

LK430 module has totally 36 bytes of user parameters.

Parameter Name	Parameter Definition	Value Options	Default Value
Data Format	Selection of the module's 6 channels measurement data output format	0=Code, reports resistance code value; 1=Temperature, reports temperature code value	1
Temperature Units	Selection of LK430 temperature units	0=Celsius 1=Fahrenheit	0
Line Break Value	Selection of line break value reported by channels	0=0x0000 85=Hold, retain data in line-break 255=0xFFFF *Refer to section "Detection of Line-break" for details*	85
CH1 Sensor Type	Selection of RTD types for Channel 1 to 6	192= Cu427:10Ω 193= Chinese_Cu:50Ω 194= Ni618:100Ω 195= Ni618:120Ω 196= Pt385:100Ω 197= Pt3916:100Ω 198= Ni618:200Ω 199=Ni672:120Ω 200=Pt385:200Ω 201= Pt3916:200Ω 202= Ni618:500Ω 203= Pt385:500Ω 204= Pt3916:500Ω 205= Pt385:1000Ω 206= Pt3916:1000Ω	196
CH2 Sensor Type			
CH3 Sensor Type			
CH4 Sensor Type			
CH5 Sensor Type			
CH6 Sensor Type			
CH1 Digital Filter	Enable the Digital Filter	0=None, no digital filter 1=8Points, filter (select 8 latest history points)	0
CH2 Digital Filter			
CH3 Digital Filter			
CH4 Digital Filter			
CH5 Digital Filter			
CH6 Digital Filter			
CH1 Upper Limit Exceeded Alarm	Enable the upper and lower limit exceeded alarm of Channel1 to 6	0=Disable, the alarm is disabled; 1= Enable, the alarm is enabled.	0
CH1 Lower Limit Exceeded Alarm			
CH2 Upper Limit Exceeded Alarm			
CH2 Lower Limit Exceeded Alarm			
CH3 Upper Limit Exceeded Alarm			
CH3 Lower Limit Exceeded Alarm			
CH4 Upper Limit Exceeded Alarm			
CH4 Lower Limit Exceeded Alarm			
CH5 Upper Limit Exceeded Alarm			
CH5 Lower Limit Exceeded Alarm			
CH6 Upper Limit Exceeded Alarm			

CH6 Lower Limit Exceeded Alarm			
CH1 Upper Limit Value CH1 Lower Limit Value CH2 Upper Limit Value CH2 Lower Limit Value CH3 Upper Limit Value CH3 Lower Limit Value CH4 Upper Limit Value CH4 Lower Limit Value CH5 Upper Limit Value CH5 Lower Limit Value CH6 Upper Limit Value CH6 Lower Limit Value CH7 Upper Limit Value CH7 Lower Limit Value CH8 Upper Limit Value CH8 Lower Limit Value	Setting of the upper and lower limits of Channel 1 to 6 (Temperature conversion value should use the thermometric standard which is selected by module configuration. Upper alarming limit must be larger than actual alarming value.)	Alarm Lower Limit Range: 6720~25980 Alarm Upper Limit Range: 6720~25980 Refer to the section “Limit Exceed Alarm” for the setting and calculation of the alarm limit values	Alarm Lower Limit: 8000 Alarm Upper Limit: 18700
CH1 Line Break Alarm CH2 Line Break Alarm CH3 Line Break Alarm CH4 Line Break Alarm CH5 Line Break Alarm CH6 Line Break Alarm CH7 Line Break Alarm CH8 Line Break Alarm	Enable the line-break alarm of Channel 1 to 6	0=Disable, alarm disabled; 1=Enable, alarm enabled	0

Table 5.56: List of LK430 User Parameters

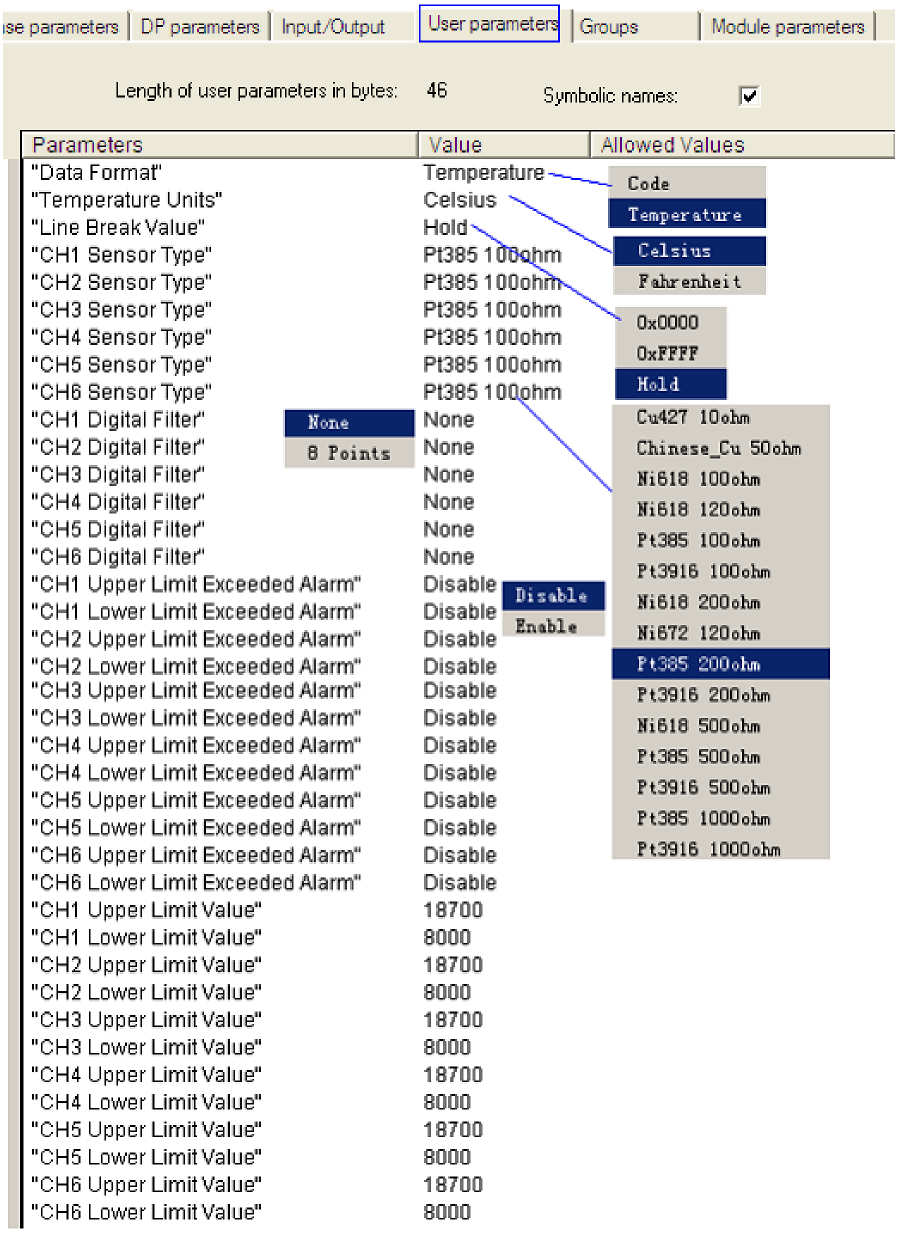


Figure 5.70: Setting of LK430 User Parameters

5.7.8 Module Installation and Un-installation

Refer to chapter 1 on "Module Insertion Mechanical keys" and "Module Insertion and Removable" for more details.

5.7.9 Technical Specification

LK430 6 Channel RTD AI Module			
System Power Supply			
Power Supply Voltage	24VDC(-15%~+20%)		
Power Consumption	65mA max@24V DC		
Input Channel			
Channel Number	6 channels;		
Measurement Method	3-Wire RTD Input, 3 Cable Connection, Constant-Current Resource Measurement		
RTD Types and Temperature Ranges	RTD Type No.	Temperature Range	Absolute Deviation
	Copper427: 10Ω	-200ºC~260ºC	1.4ºC
	Chinese_Cu: 50Ω	-50ºC~150ºC	0.6ºC
	Nickel618: 100Ω/120Ω/200Ω/500Ω	-60ºC~250ºC	0.9ºC
	Nickel672: 120Ω	-80ºC~320ºC	1.4ºC
	Platinum385: 100Ω/200Ω/500Ω/1000Ω	-200ºC~870ºC	1.3ºC
	Platinum3916: 100Ω/200Ω/500Ω/1000Ω	-200ºC~630ºC	1.3ºC
Resistance Measurement Range	1~4020Ω		
Resistance Measurement Accuracy	0.1% F.S.@25ºC		
Sample Rate Resistance Data Temperature Data	 Minimum 100ms/all channels; maximum 1.5s/all channels Minimum 150ms/all channels; maximum 2s/all channels		
Differential Mode Suppression Rate	60dB@50Hz		
Integral Mode Suppression Rate	100dB@50Hz		
Temperature Drift	±50ppm/ºC		
Calibration Precision	0.05% of full resistance range		
Calibration Period	12 months		
Isolation Voltage between Field and System	500VAC@1min, Current Leak 5mA		
Upload Data Format (0~65535)			
Upload Resistance Value	65535×(Resistance Value – Minimum measurable Resistance Value within Range) / Full Range Resistance Value		
Upload Temperature Value	Measured Temperature×10+10000		
Failure Diagnosis and Hot swap			
Diagnosis functions Line-Break Detection Limit Exceeded Alarm	In case of line-break, diagnosis byte reports 0x06, upload data of the channel can be configured through software Signal range exceeded Alarm upper/lower limits, diagnosis byte reports 0x07/0x08		
Hot swap	Support		
Communication			
Protocol	PROFIBUS-DP Slave Station, in accordance with IEC61158-3/EN50170 standards		
Baud Rate	1.5Mbps, 500Kbps, 187.5Kbps, 93.75Kbps, 45.45Kbps, 31.25Kbps, 19.2Kbps, 9.6Kbps		
Media	Communication bus is connected to the backplane through euro connector, hot redundant communication media		
Physical Features			
Mechanic Keys to Prevent Incorrect Insertion	A2		
Installation	LK local backplane or expansion backplane		
Dimension	Width × Height × Depth = 35mm×100mm×100mm		
Casing Protection Level	IEC60529 IP20		
Weight	180g		
Working Environment			

Working Temperature	0ºC~60ºC
Working Relative Humidity	5%~95%, no condensate
Storage Temperature	-40ºC~70ºC
Storage relative Humidity	5%~95%, no condensate

Table 5.57: Technical Specification of LK430 Module

5.7.10 RTD Specification

RTD type	Range Code	Resistance Value (Ω)	Temperature Range (ºC)
Cu427 10Ω	192	3.69980~21.1574	-200ºC~260ºC
Chinese_Cu 50Ω	193	39.243~82.136	-50ºC~150ºC
Ni618 100Ω	194	69.5204~343.584	-60ºC-250ºC
Ni618 120Ω	195	83.4245~412.301	-60ºC-250ºC
Pt385 100Ω	196	18.5201~396.311	-200ºC-870ºC
Pt3916 100Ω	197	16.9960~327.744	-200ºC~630ºC
Ni618 200Ω	198	139.041~687.168	-60ºC~250ºC
Ni672 120Ω	199	66.6000~568.407	-80ºC~320ºC
Pt385 200Ω	200	37.0402~792.622	-200ºC~870ºC
Pt3916 200Ω	201	33.992~655.488	-200ºC-630ºC
Ni618 500Ω	202	347.602~1717.92	-60ºC~250ºC
Pt385 500Ω	203	92.6005~1981.56	-200ºC~870ºC
Pt3916 500Ω	204	84.98~1638.72	-200ºC~630ºC
Pt385 1000Ω	205	185.201~3963.11	-200ºC~870ºC
Pt3916 1000Ω	206	169.960~3277.44	-200ºC~630ºC

Table 5.58: RTD Specification

5.8 LK440 [8 CHANNEL THERMOCOUPLE AI MODULE]

5.8.1 Features

- 8 channels of thermocouple or millivolt input
- Thermocouple type: B, E, J, K R, S, T, N, C
- Millivolt Signal Range: -12mV~+78mV
- Thermocouple type: uploads temperature value
- Support ProfiBus-DP slave station protocol
- Calibration on Field
- Upper Limit Exceeded Alarm
- Lower Limit Exceeded Alarm
- Measurement Range Exceeded Alarm
- Line-Break Alarm
- System-to-Field Isolation
- Supports hot swap

5.8.2 Operation Principles

The 24V DC system power supply of LK 440 module goes through the isolated DC/DC converter to output a 5VDC power supply for the interface circuit. This interface circuit is connected to other circuits through optical couplers to enable the isolation between the field circuit and the system. The field signals are converted through the A/D converter into digital signals. Then the digital signals are sent through photoelectric isolated circuit into the module micro-controller for processing and uploaded to the controller through DP bus.

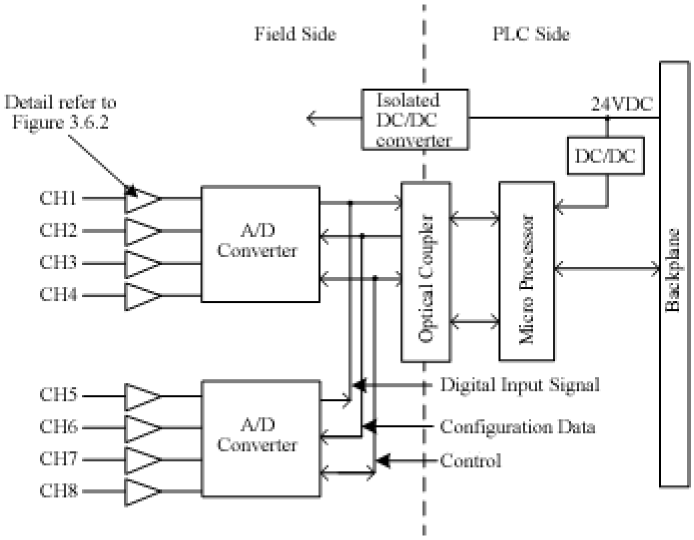


Figure 5.71: Internal Structure of LK440 Module

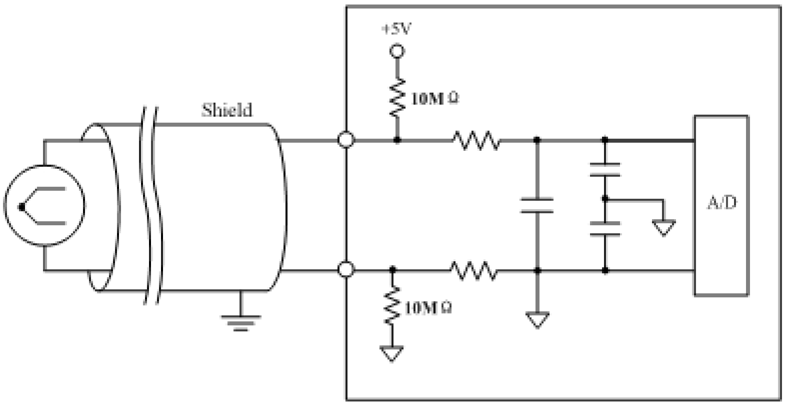


Figure 5.72: LK 440 Channel Interface Circuit

5.8.3 Indicators Definition

Refer to section 5.1.1: The LED Status indicator

5.8.4 Wiring Specifications

Wiring to Backplane Terminals

Channel Number	Terminal Number	
	TC/MV Signal Input Positive End	TC/MV Signal Input Negative End
1	01	02
2	03	04
3	05	06
4	07	08
5	09	10
6	11	12
7	13	14
8	15	16

Table 5.59: Definitions of LK440 Backplane Wiring Terminals

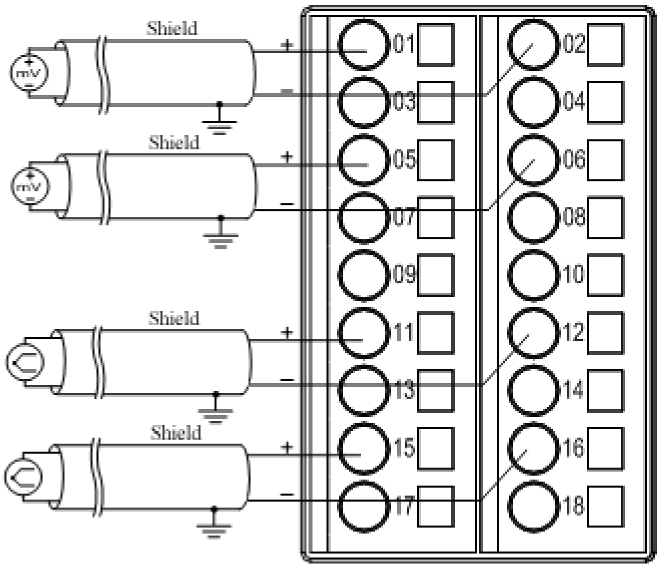


Figure 5.73: Wiring of LK440 Backplane Terminals

In the wiring, the following shall be noted:

- The 18digit double wiring terminals shall be installed on the backplane, right under the installation slot of LK414 module.
- Each channel of the AI signals that come from the field is connected to its respective terminal through two (shielded) cables.
- The odd-number terminals connect to the positive ends of voltage signals while the even-number terminals connect to the negative ends.
- Terminal "17" and "18" shall not be connected in the wiring.
- After wiring, cable connections shall be checked to ensure the correct wiring. In order to avoid dangers such as short circuit, there shall be no nude cable outside of the terminals.

Wiring to Terminal Modules

Please refer to the information found on Chapter 12: Terminal Module.

5.8.5 Function Specifications

Output Format of the Measurement Data

- LK440 module can be connect with B, E, J, K, R, S, T, N, C types of thermocouple components to acquire field temperature signals. The module can also acquire millivolt signals within range -12mV~+78mV or range -12mV~+32mv.
- The measurement data that reported by LK440 are represented by 2byte positive integer codes (decimal value 0~65535). For different ranges, the measurement data adopt different output formats. Millivolt Range outputs millivolt codes of the field signals while the Thermocouple Range outputs temperature codes.
- The conversion equation between measurement data and engineering value are as follows:
- For Millivolt Range Configuration: Millivolt Value mV=(mV code/65535)× Range -12, for the -12mv ~+78mV range, Range=90mV, for the -12mv~+32mV range, Range=44mV.
- For Thermocouple Range: Temperature Value (Celsius or Fahrenheit) = (Temperature Code-1000)/10
- For Millivolt Range, the function block HS_HEX_ENGIN in the analog conversion library HS_AnalogConvert.lib of the configuration software PowerPro V4 can be called to convert the 2byte millivolt code values into engineering data. For Thermocouple Range, the actual temperature value can be calculated simply from the abovementioned equation.

Cold End Compensation

LK440 module uses the following two methods for the cold end compensation.

- **Actually-Measured Cold-End Temperature Compensation**

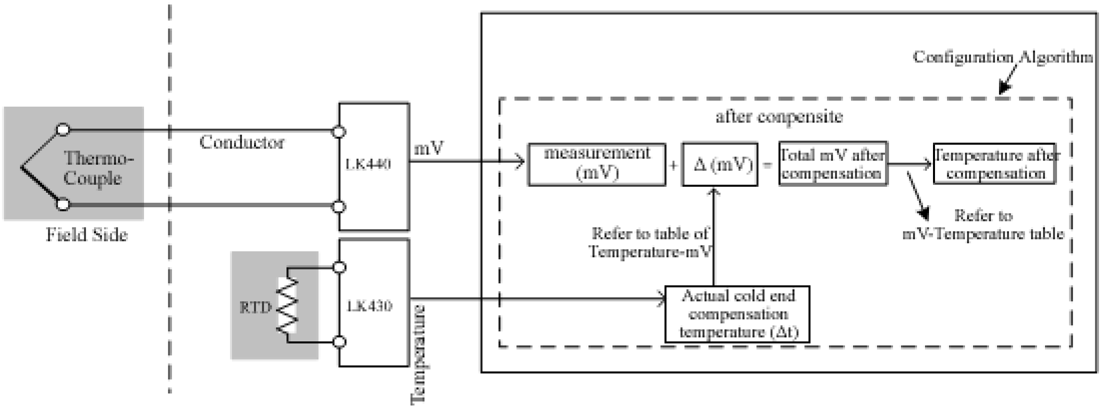


Figure 5.74: LK440 Actually-Measured Cold End Temperature Compensation

  - To use this compensation method, the LK440 module shall be configured to the Millivolt Range and report the measurement data in millivolt values.
  - The cold end temperature is measured by a RTD component, which shall be located near to the thermocouple cold end to ensure the compensation precision. This temperature signal can be acquired by LK440 module and reported to the controller. According to a "Temperature-Millivolt" conversion table of correspondence thermocouple, the controller converts the cold end temperature value into a millivolt value, and adds this cold end millivolt value to the measured millivolt value of LK440 to get the actual millivolt value after the compensation. Then, the controller changes this after-compensation millivolt value into the actual temperature value of the thermocouple field-end according to the "millivolt-temperature" conversion table. The detailed compensation algorithm can be configured by user in the programming software.
  - To select this compensation method means to disable the other method of Fixed Cold End Temperature compensation. The channel cold end compensation parameter "CHn Cold End Compensation" shall keep its default value ("disabled").

- **Fixed Cold End Temperature Compensation**

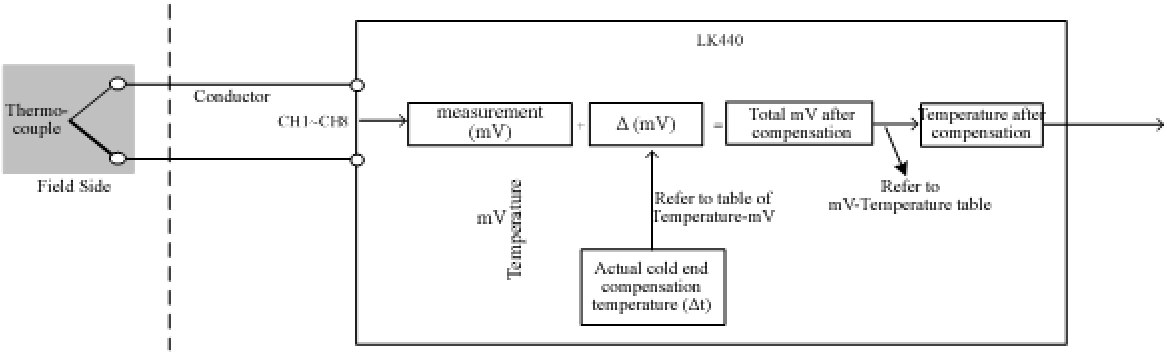


Figure 5.75: LK440 User-Defined Cold End Temperature Compensation

- In case of lower requirements on the compensation accuracy or less changes in cold end environment temperatures, a cold end temperature can be pre-set in the configuration and retain fixed. LK440 can execute the compensation according to this fixed cold end temperature. This compensation method requires the thermocouple range configuration of LK440 module that reports measurement data in temperature values.
- LK440 module acquires the millivolt value of the fixed cold end temperature according to the "Temperature-Millivolt" conversion table of correspondence thermocouple. Then LK440 adds this cold end value to the measured millivolt to get the actual millivolt value after the compensation. By convert this actual millivolt value back into temperature value according to the "Millivolt-Temperature" conversion table, the module will then get the actual temperature value of thermocouple field-end and finally report the measurement temperature code to the controller. Detailed compensation algorithm is automatically completed inside the LK440 module. The controller will get the temperature after compensation directly.

The configuration steps of Fixed Cold End Temperature Compensation are as follows:

- Select "Enable" in Cold End Compensation Enable Parameter of a correspondence channel to enable the cold end compensation function of the channel.
- Fill in the temperature compensation value in Cold End Compensation Value Parameter "Cold End Compensation Value", where the temperature compensation value = compensation temperature×10.
- The temperature units of compensation temperatures shall be consistent with those configured for LK440 module. When the temperature unit is in Celsius, the cold end temperature compensation range will be 0~60°C with the correspondence compensation value of 0~600. When the temperature unit is in Fahrenheit, the cold end temperature compensation range will be 32~140°F with the correspondence compensation value of 320~1400.

5.8.6 Specifications of Diagnosis

PowerPro V4 configuration software adopts external diagnosis library to check and acquire all kinds of diagnosis information, such as whether the module and its channels are operating normally and whether the module parameters are set correctly.

For the DP slave station modules, the DP slave station expansion diagnosis function block (HS_DPSlaveALarm) shall be called to check the DP module at any address (DP_Addr) on the PROFIBUS-DP link, as shown in Figure 5.76.

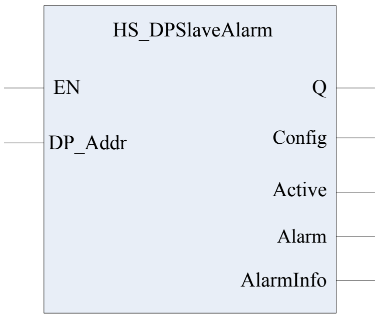


Figure 5.76: Expansion Diagnosis Function Block for DP Slave Station

For detailed usage of DP Expansion Diagnosis Function Block, please refer to LK Large Scale PLC Instruction Manual. Users shall note that the Diagnosis library is an external library that shall be first installed in the Library Manager before use.

The diagnosis information of DP slave station modules can be classified to 3 categories: device diagnosis, identifier diagnosis and channel diagnosis. All diagnosis data exist in the form of block structure.

- Device Diagnosis: records of the overall diagnosis information of the module, such as, power loss of field power supply.
- Identifier Diagnosis: records of whether the module has diagnosis information.
- Channel Diagnosis: records of the channel level diagnosis information, such as line-break and rang exceeding.

Channel diagnoses such as range exceeding, limit exceeding and line-break may be applied to LK440 module. After the DP slave station expansion diagnosis function block (HS_DPSlaveAlarm) is called, the channel diagnosis data reported by LK440 will be stored in the corresponding fields of the output parameter “AlarmInfo”, as shown in Table 5.60.

Diagnosis Information		Value	Definition
Channel Diagnosis	ChDiag.Module.Channel.ChNo	1~16	Channel Number of the Failure
	ChDiag.Module.Channel.Error	2	Short of Range
		3	Over Range
		6	Line-break
		7	Upper Limit Exceeded
		8	Lower Limit Exceeded
		0	Channel Failure Recovered

Table 5.60: Definition of LK440 Channel Diagnosis Information

Optional Alarm Functions

Each range of LK440 provides different alarm functions, as shown in Table 5.61.

Measurement Range	RTD type	Internal Range Code	Alarm Type
-12mV~78mV	—	13	Limit Exceeded Alarm Range Exceeded Alarm
-12mV~32mV	—	14	Limit Exceeded Alarm Range Exceeded Alarm
300~1820°C	B	207	Limit Exceeded Alarm Line Break Alarm
0~1725°C	C	208	Limit Exceeded Alarm Range Exceeded Alarm
0~2315°C	C	209	Limit Exceeded Alarm Line Break Alarm
-270~415°C	E	210	Limit Exceeded Alarm Range Exceeded Alarm
-270~1000°C	E	211	Limit Exceeded Alarm Line Break Alarm
-210~550°C	J	212	Limit Exceeded Alarm Range Exceeded Alarm
-210~1200°C	J	213	Limit Exceeded Alarm Line Break Alarm
-270~725°C	K	214	Limit Exceeded Alarm Range Exceeded Alarm
-270~1372°C	K	215	Limit Exceeded Alarm Line Break Alarm
-270~840°C	N	216	Limit Exceeded Alarm Range Exceeded Alarm
-270~1300°C	N	217	Limit Exceeded Alarm Line Break Alarm
-50~1768°C	R	218	Limit Exceeded Alarm Line Break Alarm
-50~1768°C	S	219	Limit Exceeded Alarm Line Break Alarm
-270~400°C	T	220	Limit Exceeded Alarm Line Break Alarm

Table 5.61: List of LK440 Alarm Functions under Different Ranges

Note: when thermocouple range is adopted, one type of thermocouple may have two optional temperature ranges. For example, the C type thermocouple has two ranges of 0~1725ºC and 0~2315ºC. When a smaller temperature range is selected in configuration, for example, 0~1725ºC range is selected for the C type thermocouple, the module will not provide direct line break detection function. However, when thermocouple break failure occurs, it will trigger the Range Exceeded Alarm of the channel. In this case, if a Range Exceeded Alarm is reported, it may because of an exceeding of channel range and may also because of a thermocouple break failure.

Measurement Range Exceeded Alarm

LK440 module provides the function of Measurement Range Exceeded Alarm. For a thermocouple, an input signal exceeding the set range means that it is out of the millivolt value range of the thermocouple's set temperature range. Channel diagnosis byte reports "Range Exceeded"; when signal fall back into the measurement range, channel reports "Failure Recovered".

LK440 module will only report the diagnosis data once respectively when signals exceeded range and when the failure is recovered.

Not every measurement range of LK440 module has the function of Range Exceeded Alarm.

Refer to section "Optional Alarm Functions" for different alarm function supported by each channel.

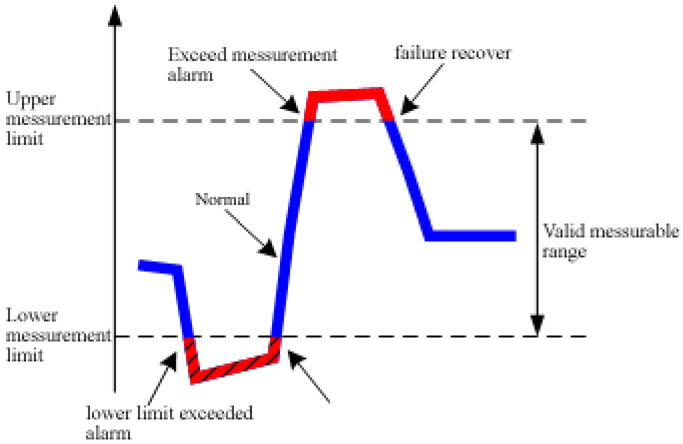


Figure 5.77: Range Exceeded Alarm of LK440

As for different ranges set by users, the module provides different diagnosis processes of rang exceeding, as shown in Figure 5.77. When signals fall back into the normal range, the channel will report diagnosis byte 0x00.

Range Type	Range Exceeding	Process of Range Exceeding
Thermocouple	Over Range	1. Channel diagnosis reports failure value 0x03 2. Channel measurement data report the maximum temperature code within the range
	Short of Range	1. Channel diagnosis reports failure value 0x02 2. Channel measurement data report the minimum temperature code within the range
Millivolt	Over Range	1. Channel diagnosis reports failure value 0x03 Channel measurement data report 0xFFFF
	Short of Range	1. Channel diagnosis reports failure value 0x02 Channel measurement data report 0x0000

Table 5.62: LK440 Processes of Limit Exceeded Alarms

Limit Exceeded Alarm

LK440 module provides limit exceeded alarm function that can flexibly set the alarm limits according to different industrial fields to detect the changes of field temperature signals and send the limit exceeded alarm in time. This significantly improves the safety level of industry control.

Users can configure the upper and lower alarm limits of input signals within the set measurement range. When input signals exceed the configured range, e.g. when they are higher than the upper alarm limit or lower than the lower limit, the channel will report diagnosis byte “exceed limits”. When input signals fall back into the configured range, the channel will report “failure recovered”.

LK440 module will only report the diagnosis data once respectively when signal exceeds limits and when the failure is recovered.

The limit exceeded alarm function of LK440 module; the upper and lower limits of each channel are all configurable through the programming software. The default value is disabled limit exceeded alarm function. Set as16digit positive integer codes in configuration, the alarm limit values are divided into Temperature Codes (in Thermocouple Range) and Millivolt Codes (in Millivolt Range). The conversion equations of which are shown in Table 5.63.

Range Type	Upper Alarm Limit (Decimal)	Lower Alarm Limit (Decimal)
Thermocouple	Upper limit temperature value×10 + 10000	Lower limit temperature value×10+10000
-12mV~+78mV	65535×(Alarm Upper Limit Millivolt Value +12) /90	65535×(Alarm Lower Limit Millivolt Value +12) /90
-12mV~+32mV	65535×(Alarm Upper Limit Millivolt Value +12) /44	65535×(Alarm Lower Limit Millivolt Value +12) /44

Table 5.63: Calculation of LK440 Alarm Limit Value Codes

For thermocouple signals, the temperature units (Celsius or Fahrenheit) of the alarm upper and lower limits must be consistent with those adopted by the module, which can be configured by parameter "Temperature Units" with a default value of Celsius.

The alarm lower limit range is 0~65535 while its default value is 0; the alarm upper limit range is 1~65535 while its default value is 65535. The upper alarm current limit shall be higher than the lower limit, otherwise LK440 module will not be able to correctly report diagnosis information.

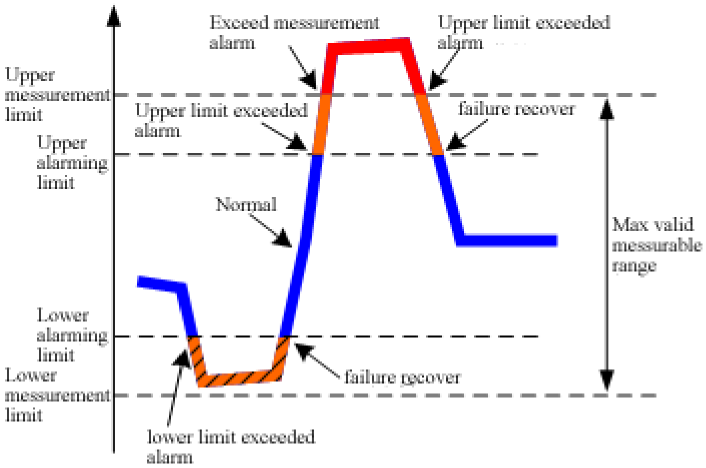


Figure 5.78: Limit Exceeded Alarm of LK440

As for different ranges set by users, the module provides different diagnosis processes of rang exceeding, as shown in Table 5.64. When signals fall back into the normal range, the channel will report diagnosis byte 0x00.

Range Type	Limit Exceeding	Process of Limit Exceeded Alarm
Thermocouple	Upper Limit Exceeded	Channel diagnosis reports failure value 0x07 The channel reports the current temperature code value.
	Lower Limit Exceeded	Channel diagnosis reports failure value 0x08 The channel reports the current temperature code value.
Millivolt	Upper Limit Exceeded	Channel diagnosis reports failure value 0x07 The channel reports the current millivolt code value.
	Lower Limit Exceeded	Channel diagnosis reports failure value 0x08 The channel reports the current millivolt code value.

Table 5.64: LK440 Processes of Limit Exceeded Alarms

For ranges that support both range exceeded alarm and limit exceeded alarm, LK440 will only report the exceeding of range If the limit exceeded alarm is enabled, and the limit exceeding and range exceeding occur at the same time.

Line-Break Detection

A 10MΩ pull-up resistor is connected to the signal channel of LK440 module to detect line-break failures.

When there is line-break in an input channel, the positive-end voltage of the channel will be pulled up to +5V and the negative-end voltage will be pulled down to GND, then the voltage difference on the input-end of AD

transfer will reach the maximum value. The channel will report “Line-Break”. After the channel is reconnected, it will report “Failure Recovered”.

LK430 module will only report the diagnosis data once respectively when line-break occurs and when the failure is recovered.

For thermocouple ranges, not all of them support line-break detection function. For millivolt ranges, LK440 module does not support line-break detection. *Refer to section “Optional Alarm Functions” for details.*

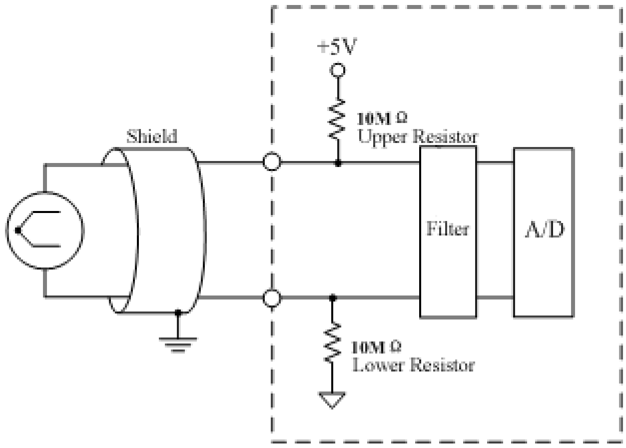


Figure 5.79: Principle of LK440 Line-Break Detection

- When there is line-break of a channel's thermocouple signals:
- Channel diagnosis reports line-break failure value 0x06
- It can be configured whether the channel retains the data before line-break or report the maximum temperature value code within the measurement range.
- When the line-break is recovered, the channel diagnosis reports 0x00

5.8.7 Parameter Specifications

Communication Parameters

Supporting PROFIBUS-DP slave station protocol, LK440 completes data exchanges and diagnosis information reporting with the controller and other DP master stations. The slave station adopts a unique communication address, which is determined by the backplane number and the slot number of the LK440 module.

In the configuration software, the correct communication address of the slave station shall be filled in the LK410 module DP parameter field. Other communication parameters shall keep their default values.

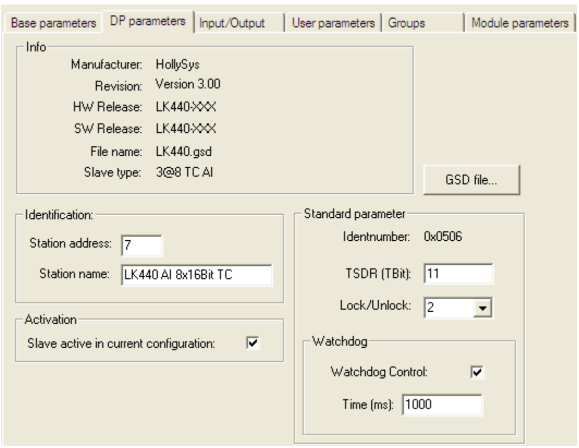


Figure 5.80: Setting of LK440 Communication Parameters

User Parameters

LK440 module has totally 48 bytes of user parameters.

Parameter Name	Parameter Definition	Parameter Value
Temperature Units	Selection of thermocouple temperature units	0: Celsius, Celsius Temperature Units (Default);

		1: Fahrenheit, Fahrenheit Temperature Units
Filter Mode	Hardware Filter Mode Selection	0: No Filter, no filter, whole channel scan time 95ms; 1: 10Hz Filter, 10Hz filter, whole channel scan time 1460ms; 2: 50Hz Filter, 50Hz filter, whole channel scan time 500ms (Default); 3: 60Hz Filter, 60Hz filter, whole channel scan time 410ms; 4: 400Hz Filter, 400Hz filter, whole channel scan time 95ms;
Line Break Value	Channel report value of line-break failure	0: Hold, report the normal value before line-break (Default); 1: Rang Maximum Value, report the range maximum value
CH1 Input Range	Range Selection of Channel 1 (The setting of "Range Selection" for individual channel would not affect others. It is allowed to have different "Range Selection" setting for different channels.)	13: "-12mV~+78mv" (Default) 14: "-12mV~+32mV" 207: B type Thermocouple, 300~1820°C 208: C type Thermocouple, 0~1725°C 209: C type Thermocouple, 0~2315°C 210: E type Thermocouple, -270~415°C 211: E type Thermocouple, -270~1000°C 212: J type Thermocouple, -210~550°C 213: J type Thermocouple, -210~1200°C 214: K type Thermocouple, -270~725°C 215: K type Thermocouple, -270~1372°C 216: N type Thermocouple, -270~840°C 217: N type Thermocouple, -270~1300°C 218: R type Thermocouple, -50~1768°C 219: S type Thermocouple, -50~1768°C 220: T type Thermocouple, -270~400°C
CH2 Input Range	Range Selection of Channel 2	
CH3 Input Range	Range Selection of Channel 3	
CH4 Input Range	Range Selection of Channel 4	
CH5 Input Range	Range Selection of Channel 5	
CH6 Input Range	Range Selection of Channel 6	
CH7 Input Range	Range Selection of Channel 7	
CH8 Input Range	Range Selection of Channel 8	
CH1 Cold End Compensation	Enable cold end compensation of CH1	0: Disable, the function is disabled (default); 1: Enable, the function is enabled.
CH2 Cold End Compensation	Enable cold end compensation of CH2	
CH3 Cold End Compensation	Enable cold end compensation of CH3	
CH4 Cold End Compensation	Enable cold end compensation of CH4	
CH5 Cold End Compensation	Enable cold end compensation of CH5	
CH6 Cold End Compensation	Enable cold end compensation of CH6	
CH7 Cold End Compensation	Enable cold end compensation of CH7	
CH8 Cold End Compensation	Enable cold end compensation of CH8	
Cold End Compensation Value	Configuration of cold end temperature compensation value (Using "CHx Cold Junction Compensation" parameter to enable LK440 cold junction compensation function.)	Celsius Temperature Units: 0~600 (of Range 0~60ºC) Fahrenheit Temperature Units: 320~1400 (of Range 32~140°F) Compensation Value = Compensation Temperature×10, default value is 0.
CH1 Digital Filter	Software Filter Selection of Channel 1 (The setting of "Software filter Selection" for individual channel would not affect others. It is allowed to have different "Software filter Selection" setting for different channels.)	0=None, no software filter (default value) 1=3Points, filter (select 3 latest history points) 2=5Points, filter (select 5 latest history points) 3=7Points, filter (select 7 latest history points)
CH2 Digital Filter	Software Filter Selection of Channel 2	
CH3 Digital Filter	Software Filter Selection of Channel 3	
CH4 Digital Filter	Software Filter Selection of Channel 4	
CH5 Digital Filter	Software Filter Selection of Channel 5	
CH6 Digital Filter	Software Filter Selection of Channel 6	
CH7 Digital Filter	Software Filter Selection of Channel 7	

CH8 Digital Filter	Software Filter Selection of Channel 8	
CH1 Upper Limit Exceeded Alarm	Enable the Upper Limit Exceeded Alarm of Channel 1	0: Disable, the function is disabled (default); 1: Enable, the function is enabled.
CH1 Lower Limit Exceeded Alarm	Enable the Lower Limit Exceeded Alarm of Channel 1	
CH2 Upper Limit Exceeded Alarm	Enable the Upper Limit Exceeded Alarm of Channel 2	
CH2 Lower Limit Exceeded Alarm	Enable the Lower Limit Exceeded Alarm of Channel 2	
CH3 Upper Limit Exceeded Alarm	Enable the Upper Limit Exceeded Alarm of Channel 3	
CH3 Lower Limit Exceeded Alarm	Enable the Lower Limit Exceeded Alarm of Channel 3	
CH4 Upper Limit Exceeded Alarm	Enable the Upper Limit Exceeded Alarm of Channel 4	
CH4 Lower Limit Exceeded Alarm	Enable the Lower Limit Exceeded Alarm of Channel 4	
CH5 Upper Limit Exceeded Alarm	Enable the Upper Limit Exceeded Alarm of Channel 5	
CH5 Lower Limit Exceeded Alarm	Enable the Lower Limit Exceeded Alarm of Channel 5	
CH6 Upper Limit Exceeded Alarm	Enable the Upper Limit Exceeded Alarm of Channel 6	
CH6 Lower Limit Exceeded Alarm	Enable the Lower Limit Exceeded Alarm of Channel 6	
CH7 Upper Limit Exceeded Alarm	Enable the Upper Limit Exceeded Alarm of Channel 7	
CH7 Lower Limit Exceeded Alarm	Enable the Lower Limit Exceeded Alarm of Channel 7	
CH8 Upper Limit Exceeded Alarm	Enable the Upper Limit Exceeded Alarm of Channel 8	
CH8 Lower Limit Exceeded Alarm	Enable the Lower Limit Exceeded Alarm of Channel 9	
CH1 Upper Limit Value	Setting the Alarm Upper Limit Value of Channel 1	Alarm Lower Limit Range: 0(default)~65534 Alarm Upper Limit Range: 1~65535(default) Refer to the section “Limit Exceed Alarm” for the setting and calculation of the alarm limit values
CH1 Lower Limit Value	Setting the Alarm Lower Limit Value of Channel 1	
CH2 Upper Limit Value	Setting the Alarm Upper Limit Value of Channel 2	
CH2 Lower Limit Value	Setting the Alarm Lower Limit Value of Channel 2	
CH3Upper Limit Value	Setting the Alarm Upper Limit Value of Channel 3	
CH3 Lower Limit Value	Setting the Alarm Lower Limit Value of Channel 3	
CH4 Upper Limit Value	Setting the Alarm Upper Limit Value of Channel 4	
CH4 Lower Limit Value	Setting the Alarm Lower Limit Value of Channel 4	
CH5 Upper Limit Value	Setting the Alarm Upper Limit Value of Channel 5	
CH5 Lower Limit Value	Setting the Alarm Lower Limit Value of Channel 5	
CH6 Upper Limit Value	Setting the Alarm Upper Limit Value of Channel 6	
CH6 Lower Limit Value	Setting the Alarm Lower Limit Value of Channel 6	
CH7 Upper Limit Value	Setting the Alarm Upper Limit Value of Channel 7	
CH7 Lower Limit Value	Setting the Alarm Lower Limit Value of Channel 7	
CH8 Upper Limit Value	Setting the Alarm Upper Limit Value of Channel 8	
CH8 Lower Limit Value	Setting the Alarm Lower Limit Value of Channel 8	

Table 5.65: List of LK440 User Parameters

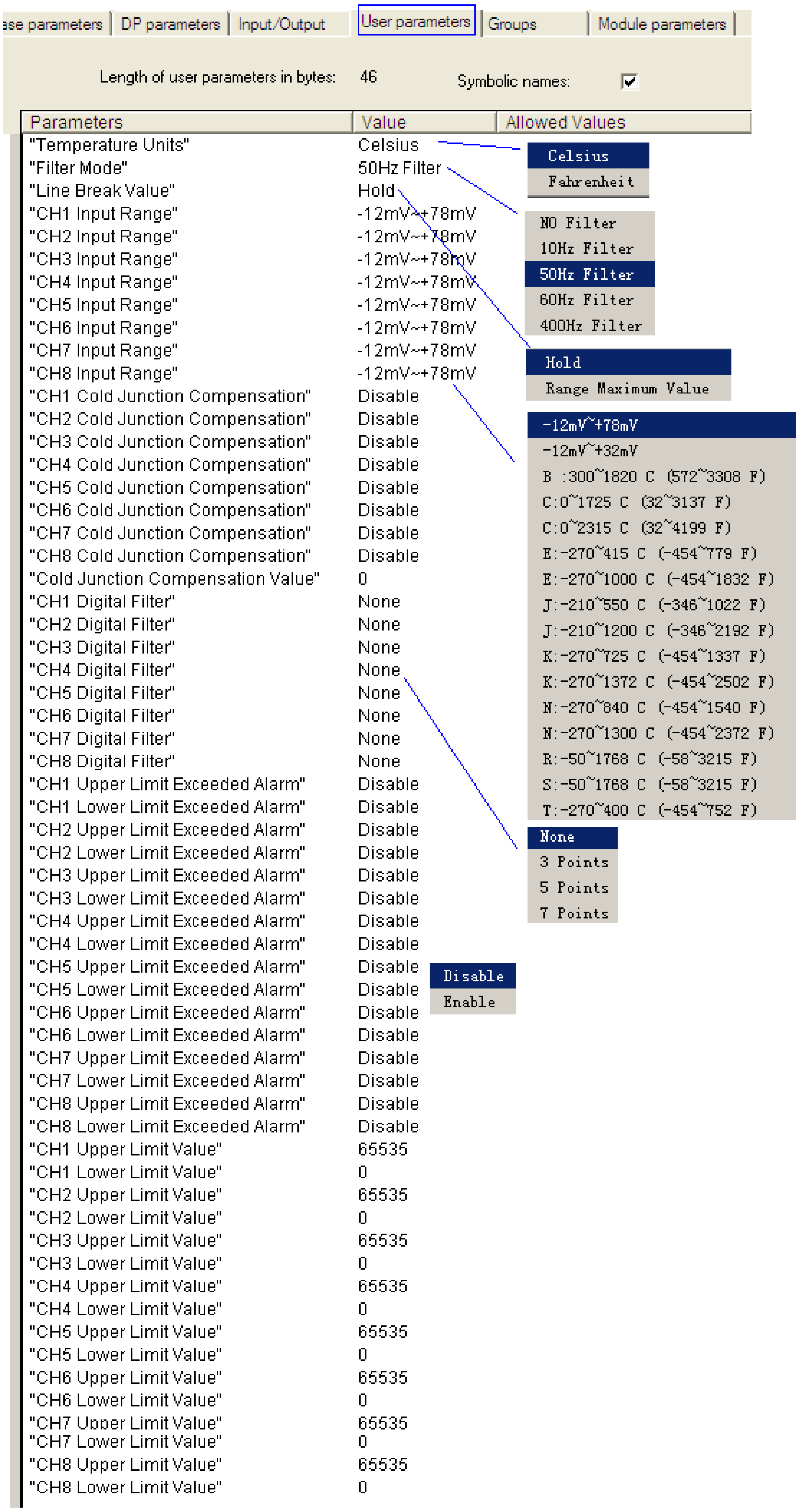


Figure 5.81: Setting of LK440 User Parameters

5.8.8 Module Installation and Un-installation

Refer to chapter 1 on "Module Insertion Mechanical keys" and "Module Insertion and Removable" for more details.

5.8.9 Technical Specification

LK440 8 Channel Thermocouple AI Module		
System Power Supply		
Power Supply Voltage	24VDC(-15%~+20%)	
Power Consumption	60mA max@24V DC	
Input Channel		
Number of Channels	8	
Signal Type	B, C, E, J, K, N, R, S, T types of Thermocouple or -12mV~+78mV / -12mV~+32mV	
Measurement Range of Thermocouple Temperature	-12mV~+78mv Range	-12mV~+32mv Range
B type		300~1820°C(572~3308°F)
C type	0~2315°C(32~4199°F)	0~1725°C(32~3137°F)
E type	-270~1000°C(-454~1832°F)	-270~415°C(-454~779°F)
J type	-210~1200°C(-346~2192°F)	-210~550°C(-346~1022°F)
K type	-270~1372°C(-454~2502°F)	-270~725°C(-454~1337°F)
N type	-270~1300°C(-454~2372°F)	-270~840°C(-454~1544°F)
R type		-50~1768°C(-58~3215°F)
S type		-50~1768°C(-58~3215°F)
T type		-270~400°C(-454~752°F)
Temperature Resolution of the Thermocouple Type: B, R, S, C Type: E, J, K, T, N	 0.15°C(0.28°F) 0.05°C(0.09°F)	 0.08°C(0.15°F) 0.03°C(0.05°F)
A/D Converter Resolution	16digit	
Voltage Measurement Precision	0.1% F.S.@25ºC	
Temperature Drift	±15ppm/ºC	
Differential Mode Suppression Rate	60dB	
Integral Mode Suppression Rate	100dB	
Input Impedance	10MΩmin	
Whole Channel Scanning Time	95ms, 410ms, 500ms, 1460ms, optional in configuration	
Establishment Time	1s max to enter the ±1% errors range of the full measurement range	
Channel Band-width	15Hz	
Voltage Calibration Precision	<0.04% F.S.@25ºC	
Calibration Period	12 months	
Isolation Voltage between Field and System	500VAC@1min, Current Leak 5mA	
Upload Data Format (0~65535)		
Millivolt Range	65535×(millivolt voltage +12)/Range	
Thermocouple Range	Measured Temperature×10+10000	
Failure Diagnosis and Hot swap		
Diagnosis functions **Limit Exceeded Alarm** **Range Exceeded Alarm** (For Limit Exceeded Alarm please refer to paragraph "Optional Alarm Functions".) **Detection of Line-Break** (For Range Exceeded Alarm please refer to paragraph "Optional Alarm Functions".)	 Signal range exceeded Alarm upper/lower limits, diagnosis byte reports 0x07/0x08 Signal exceeded range upper/lower limits, diagnosis byte reports 0x03/0x02 Line-break of channel, diagnosis reports 0x06, channel measurement data reports the range maximum value or the normal value before the line-break	
Hot swap	Support	
Communication Bus		
protocol	PROFIBUS-DP Slave Station, in accordance with IEC61158-3/EN50170 standards	
Baud Rate	Baud Rate Options: 1.5Mbps, 500Kbps, 187.5Kbps, 93.75Kbps, 45.45Kbps, 31.25Kbps, 19.2Kbps, 9.6Kbps	
Media	Communication bus is connected to the backplane through euro connector, hot redundant communication media	
Physical Features		
Mechanic Keys to Prevent Incorrect Insertion	B1	
Installation Location	LK local backplane or expansion backplane	
Dimension	Width × Height × Depth = 35mm×100mm×100mm	

Casing Protection Level	IEC60529 IP20
Weight	180g
Working Environment	
Working Temperature	0ºC~60ºC
Working Relative Humidity	5%~95%, no condensate
Storage Temperature	-40ºC~70ºC
Storage relative Humidity	5%~95%, no condensate

Table 5.66: Technical Specification of LK440 Module

5.8.10 Appendix: Typical Value Measurement Deviation in Different Ranges

(Environment Temperature 25ºC, Measurement Errors Units in the following table: ºC)

Typical Application	Correspondence Thermocouple of -12~78mV Range							
	B	R	S	E	J	K	N	T
-200ºC				0.2	0.2	0.4	0.3	0.1
0ºC				0.1	0.4	0.2	0.2	0.1
200ºC		0.3	0.3	0.1	0.1	0.2	0.2	0.0
400ºC		0.2	0.2	0.1	0.1	0.1	0.2	0.0
600ºC	0.5	0.1	0.3	0.1	0.0	0.1	0.1	
800ºC	0.5	0.2	0.1	0.0	0.0	0.1	0.1	
1000ºC	0.3	0.2	0.4	0.0	0.0	0.2	0.1	
1200ºC	0.1	0.2	0.3		0.0	0.1	0.1	
1400ºC	0.5	0.2	0.3					
1600ºC	0.3	0.2	0.3					
1800ºC	0.3							
Typical Application	Correspondence Thermocouple of -12~32mV Range							
	B	R	S	E	J	K	N	T
-200ºC				0.2	0.2	0.4	0.3	0.1
0ºC				0.1	0.4	0.2	0.2	0.1
200ºC		0.3	0.3	0.1	0.1	0.2	0.2	0.0
400ºC		0.2	0.2	0.1	0.1	0.1	0.2	0.0
600ºC	0.5	0.1	0.3			0.1	0.1	
800ºC	0.5	0.2	0.1				0.1	
1000ºC	0.3	0.2	0.4					
1200ºC	0.1	0.2	0.3					
1400ºC	0.5	0.2	0.3					
1600ºC	0.3	0.2	0.3					
1800ºC	0.3							

Table 5.67: LK 440 Typical Value Measurement Deviation in Different Ranges

5.9 LK441 [8 CHANNEL THERMOCOUPLE] (WITH COLD END COMPENSATION) AI MODULE

5.9.1 Features

- 8 channels of thermocouple or millivolt input
- Thermocouple type: B, E, J, K R, S, T, N, C
- Millivolt Signal Range: -12mV~+78mV
- Thermocouple type: uploads temperature value
- Support ProfiBus-DP slave station protocol
- Calibration on Field
- RTD cold end temperature compensation
- Limit Exceeded Alarm
- Measurement Range Exceeded Alarm
- Line-Break Alarm
- System-to-Field Isolation
- Supports hot swap

5.9.2 Operation Principles

The 24V DC system power supply of LK 441 module goes through the isolated DC/DC converter to output a 5VDC power supply for the interface circuit. This interface circuit is connected to other circuits through optical couplers to enable the isolation between the field circuit and the system. The field signals are converted through the A/D converter into digital signals. Then the digital signals are sent through photoelectric isolated circuit into the module micro-controller for processing and uploaded to the controller through PROFIBUS-DP bus.

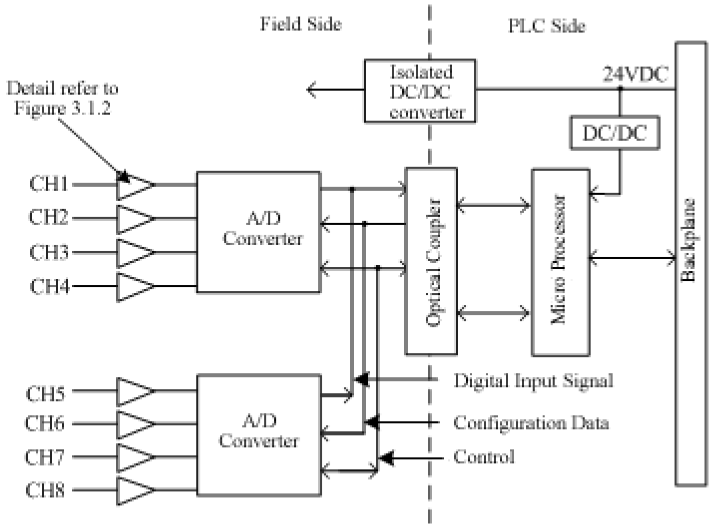


Figure 5.82: Internal Structure of LK441 Module

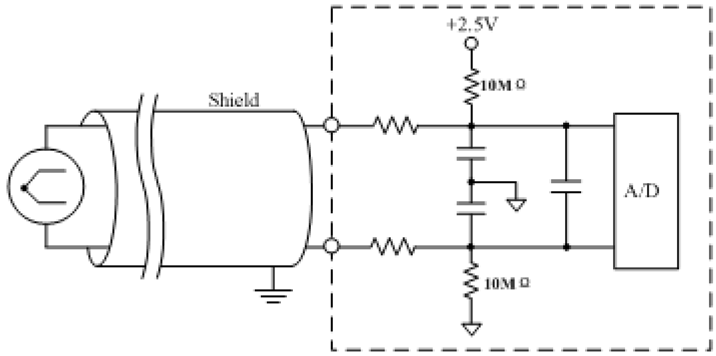


Figure 5.83: LK 441 Channel Interface Circuit

5.9.3 Indicators Definition

Refer to section 5.1.1: The LED Status indicator

5.9.4 Wiring Specifications

Wiring to Backplane Terminals

Channel Number	Terminal Number	
	TC/MV Signal Input Positive End	TC/MV Signal Input Negative End
1	01	02
2	03	04
3	05	06
4	07	08
5	09	10
6	11	12
7	13	14
8	15	16
Cold End Compensation Channel	Connection to RTD Temperature Measurement Components	
9	17	18

Table 5.68: Definitions of LK441 Backplane Wiring Terminals

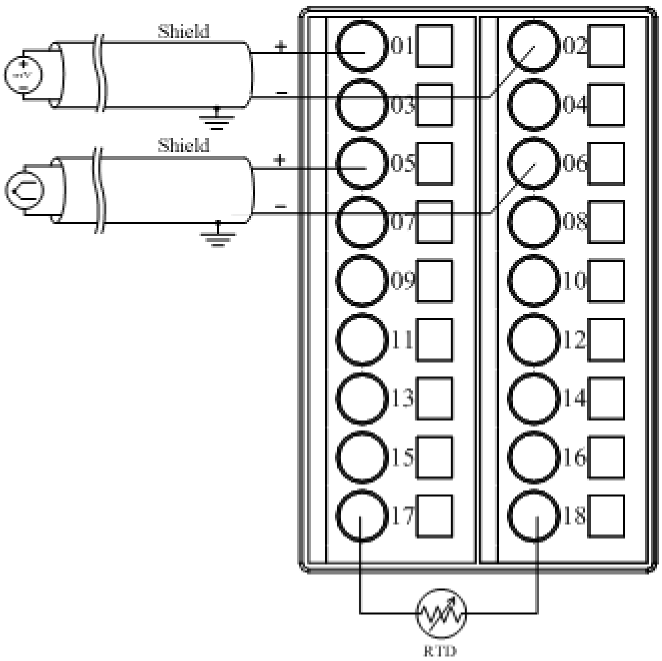


Figure 5.84: Wiring of LK441 Backplane Terminals

In the wiring, the following shall be noted:

- The 18digit double wiring terminals shall be installed on the backplane, right under the installation slot of LK441 module.
- Each channel of the AI signals that come from the field is connected to its respective terminal through two (shielded) cables.
- The odd-number terminals connect to the positive ends of voltage signals while the even-number terminals connect to the negative ends.
- In case the cold end temperature compensation is adopted, Terminal "17" and "18" will not be in use.

Wiring to Terminal Modules

Please refer to the information found on Chapter 12: Terminal Module.

5.9.5 Function Specifications

Output Format of the Measurement Data

LK441 module can be connect with B, E, J, K, R, S, T, N, C types of thermocouple components to acquire field temperature signals. The module can also acquire millivolt signals within range -12mV~+78mV or range -12mV~+32mv.

The measurement data that reported by LK441 are represented by 2byte positive integer codes (decimal value 0~65535). For different ranges, the measurement data adopt different output formats. Millivolt Range outputs millivolt codes of the field signals while the Thermocouple Range outputs temperature codes. The conversion equation between measurement data and engineering value are as follows:

- For Millivolt Range Configuration: Millivolt Value mV=(mV code/65535)× Range -12, for the -12mv ~+78mV range, Range=90mV, for the -12mv~+32mV range, Range=44mV.
- For Thermocouple Range: Temperature Value (Celsius or Fahrenheit) = (Temperature Code-1000)/10
- For Millivolt Range, the function block HS_HEX_ENGIN in the analog conversion library HS_AnalogConvert.lib of the configuration software PowerPro V4 can be called to convert the 2byte millivolt code values into engineering data. For Thermocouple Range, the actual temperature value can be calculated simply from the abovementioned formula.

Cold End Compensation

Lk441 module can execute cold end compensation through the following two methods, both of which require that LK441 be configured to the Thermocouple Range and report temperature values (e.g. temperature codes) to the controller as measurement data.

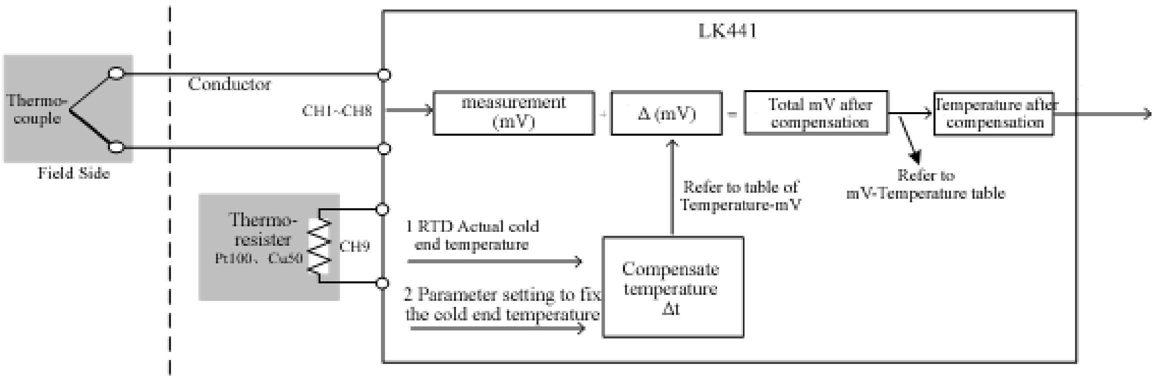


Figure 5.85: LK441 Cold End Temperature Compensation

RTD Measured Cold End Temperature Compensation

LK441 module use a RTD temperature component to measure the actual temperature at the cold end of the thermocouple. Then the millivolt value of this actually measured cold end temperature will be automatically converted according to the "Temperature – Millivolt" table of the correspondence thermocouple. This converted millivolt value will be added to the millivolt value measured by LK441 channel to get the actual millivolt value after compensation. The compensated millivolt value will be converted to get the actual temperature value at the thermocouple field-end according to the "Millivolt –Temperature" table. This actual temperature code will be reported to the controller in the end. The detailed compensation algorithm is automatically completed inside of LK441. The controller will get the temperature after compensation directly.

The external RTD temperature component occupies the internal 9th channel of LK441 module. There are 3 options of Chinese_Cu50ohm, Pt385 100ohm and Pt9316 100ohm RTDs for this RTD component with a cold end temperature compensation range of 0~60°C. It is recommended to use PT385 100ohm or Pt3916 100ohm RTD. The RTD shall be installed as near as possible to the thermocouple cold end (e.g. near the out port of LK441).

The configuration steps of RTD Measured Cold End Temperature Compensation are as follows:

- Select "Enable" in Cold End Compensation Enable Parameter "CHn Cold End Compensation" of a correspondence channel to enable the cold end compensation function of the channel.
- Select "RTD" in Cold End Method Parameter "Cold End Comp.Source".
- Select the connected RTD component from types of Chinese_Cu 50ohm, Pt385 100ohm or Pt3916 100ohm in RTD Temperature Component Parameter "Cold End Comp.RTD Type".

The Line-Break Detection of RTD temperature channel can be enabled by parameter "RTD Line Break Alarm", the default value of which is "Disabled". After the line-break detection is enabled, if there is any line-break in the RTD temperature channel (9th channel), the channel retains the normal data before the break and reports diagnosis data of line-break failure value 6.

Fixed Cold End Temperature Compensation

In case of lower requirements on the compensation accuracy or less changes in cold end environment temperatures, a cold end temperature can be pre-set in the configuration and retain fixed. LK441 module can compensate based on this fixed cold end temperature.

LK441 module acquires the millivolt value of the fixed cold end temperature according to the "Temperature-Millivolt" conversion table of correspondence thermocouple. Then LK441 adds this cold end value to the measured millivolt to get the actual millivolt value after the compensation. By convert this actual millivolt value back into temperature value according to the "Millivolt-Temperature" conversion table, the module will then get the actual temperature value of thermocouple field-end and finally report the measurement temperature code to the controller. The detailed compensation algorithm is automatically completed inside of LK441. The controller will get the temperature after compensation directly.

The configuration steps of Fixed Cold End Temperature Compensation are as follows:

- Select "Enable" in Cold End Compensation Enable Parameter "CHn Cold End Compensation" of a correspondence channel to enable the cold end compensation function of the channel.
- Select "Cold End Offset" in Cold End Method Parameter "Cold End Comp.Source".
- Fill in the temperature compensation value in Cold End Compensation Value Parameter "Cold End Compensation Value", where the temperature compensation value = compensation temperature×10.

The temperature units of compensation temperatures shall be consistent with those configured for LK441 module. When the temperature unit is in Celsius, the cold end temperature compensation range will be 0~60°C with the correspondence compensation value of 0~600. When the temperature unit is in Fahrenheit, the cold end temperature compensation range will be 32~140°F with the correspondence compensation value of 320~1400.

5.9.6 Specifications of Diagnosis

PowerPro V4 configuration software adopts external diagnosis library to check and acquire all kinds of diagnosis information, such as whether the module and its channels are operating normally and whether the module parameters are set correctly.

For the DP slave station modules, the DP slave station expansion diagnosis function block (HS_DPSlaveALarm) shall be called to check the DP module at any address (DP_Addr) on the PROFIBUS-DP link, as shown in Figure 5.86.

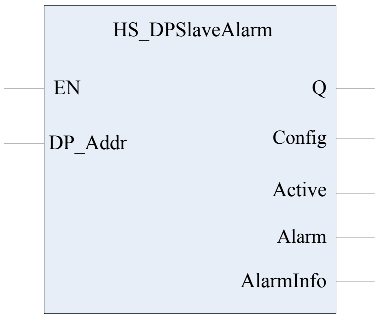


Figure 5.86: Expansion Diagnosis Function Block for DP Slave Station

For detailed usage of DP Expansion Diagnosis Function Block, please refer to LK Large Scale PLC Instruction Manual. Users shall note that the Diagnosis library is an external library that shall be first installed in the Library Manager before use.

The diagnosis information of DP slave station modules can be classified to 3 categories: device diagnosis, identifier diagnosis and channel diagnosis. All diagnosis data exist in the form of block structure.

- **Device Diagnosis**: records of the overall diagnosis information of the module, such as, power loss of field power supply.

- **Identifier Diagnosis**: records of whether the module has diagnosis information.
- **Channel Diagnosis:** records of the channel level diagnosis information, such as line-break and rang exceeding.

Channel diagnoses such as range exceeding, limit exceeding and line-break may be applied to LK441 module. After the DP slave station expansion diagnosis function block (HS_DPSlaveAlarm) is called, the channel diagnosis data reported by LK441 will be stored in the corresponding fields of the output parameter "AlarmInfo", as shown in Table 5.69

Diagnosis Information		Value	Definition
Channel Diagnosis	ChDiag.Module.Channel.ChNo	1~16	Channel Number of the Failure
	ChDiag.Module.Channel.Error	2	Short of Range
		3	Over Range
		6	Line-Break
		7	Upper Limit Exceeded
		8	Lower Limit Exceeded
		0	Channel Failure Recovered

Table 5.69: Definition of LK441 Channel Diagnosis Information

5.9.7 Optional Alarm Functions

Each range of LK441 provides different alarm functions, as shown in Table 5.70.

Measurement Range	RTD type	Internal Range Code	Alarm Type
-12mV~78mV	—	13	Limit Exceeded Alarm Range Exceeded Alarm
-12mV~32mV	—	14	Limit Exceeded Alarm Range Exceeded Alarm
300~1820°C	B	207	Limit Exceeded Alarm Line Break Alarm
0~1725°C	C	208	Limit Exceeded Alarm Range Exceeded Alarm
0~2315°C	C	209	Limit Exceeded Alarm Line Break Alarm
-270~415°C	E	210	Limit Exceeded Alarm Range Exceeded Alarm
-270~1000°C	E	211	Limit Exceeded Alarm Line Break Alarm
-210~550°C	J	212	Limit Exceeded Alarm Range Exceeded Alarm
-210~1200°C	J	213	Limit Exceeded Alarm Line Break Alarm
-270~725°C	K	214	Limit Exceeded Alarm Range Exceeded Alarm
-270~1372°C	K	215	Limit Exceeded Alarm Line Break Alarm
-270~840°C	N	216	Limit Exceeded Alarm Range Exceeded Alarm
-270~1300°C	N	217	Limit Exceeded Alarm Line Break Alarm
-50~1768°C	R	218	Limit Exceeded Alarm Line Break Alarm
-50~1768°C	S	219	Limit Exceeded Alarm Line Break Alarm
-270~400°C	T	220	Limit Exceeded Alarm Line Break Alarm

Table 5.70: List of LK440 Alarm Functions under Different Ranges

Note: when thermocouple range is adopted, one type of thermocouple may have two optional temperature ranges. For example, the C type thermocouple has two ranges of 0~1725ºC and 0~2315ºC. When a smaller temperature range is selected in configuration, for example, 0~1725ºC range is selected for the C type thermocouple, the module will not provide direct line break detection function. However, when thermocouple break failure occurs, it will trigger the Range Exceeded Alarm of the channel. In this case, if a Range Exceeded Alarm is reported, it may because of an exceeding of channel range and may also because of a thermocouple break failure.

Measurement Range Exceeded Alarm

LK441 module provides the function of Measure Range Exceeded Alarm. For a thermocouple, an input signal exceeding the set range means that it is out of the millivolt value range of the thermocouple's set temperature range. Channel diagnosis byte reports "Range Exceeded"; when signal fall back into the measurement range, channel reports "Failure Recovered".

Not every measurement range of LK441 module has the function of Range Exceeded Alarm. *Refer to section "Optional Alarm Functions" for different alarm function supported by each channel.*

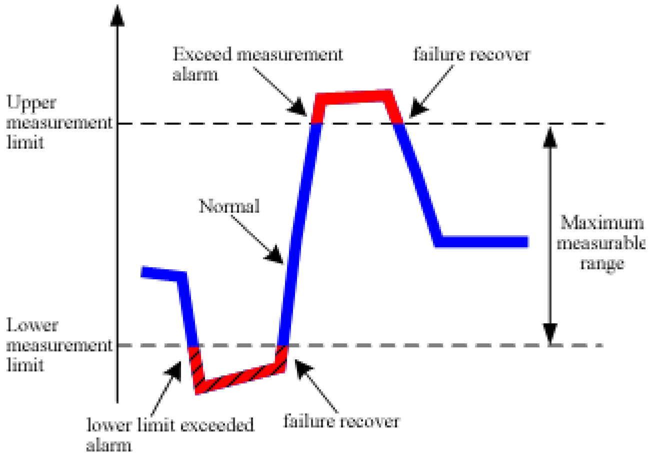


Figure 5.87: Range Exceeded Alarm of LK441

As for different ranges set by users, the module provides different diagnosis processes of rang exceeded alarm, as shown in Table 5.71. When signals fall back into the normal range, the channel will report diagnosis byte 0x00.

LK441 module will only report the diagnosis data once respectively when signals exceeded range and when the failure is recovered.

Range Type	Range Exceeding	Process of Range Exceeding
Thermocouple	Over Range	1. Channel diagnosis reports failure value 0x03 2. Channel measurement data report the maximum temperature code within the range
	Short of Range	1. Channel diagnosis reports failure value 0x02 2. Channel measurement data report the minimum temperature code within the range
Millivolt	Over Range	1. Channel diagnosis reports failure value 0x03 CChannel measurement data report 0xFFFF
	Short of Range	1. Channel diagnosis reports failure value 0x02 CChannel measurement data report 0x0000

Table 5.71: LK441 Processes of Limit Exceeded Alarms

Limit Exceeded Alarm

LK441 module provides limit exceeded alarm function that can flexibly set the alarm limits according to different industrial fields to detect the changes of field temperature signals and send the limit exceeded alarm in time. This significantly improves the safety level of industry control.

Users can configure the upper and lower alarm limits of input signals within the set measurement range. When input signals exceed the configured range, e.g. when they are higher than the upper alarm limit or lower than the lower limit, the channel will report diagnosis byte “exceed limits”. When input signals fall back into the configured range, the channel will report “failure recovered”.

The limit exceeded alarm function of LK441 module; the upper and lower limits of each channel are all configurable through the programming software. The default value of limit exceeded alarm function setting is “Disabled”. Set as16digit positive integer codes in configuration, the alarm limit values are divided into Temperature Codes (in Thermocouple Range) and Millivolt Codes (in Millivolt Range). The conversion equations of which are shown in Table 5.72.

Range Type	Upper Alarm Limit (Decimal)	Lower Alarm Limit (Decimal)
Thermocouple	Upper limit temperature value×10+10000	Lower limit temperature value×10+10000
-12mV~+78mV	65535×(Alarm Upper Limit Millivolt Value +12) /90	65535×(Alarm Lower Limit Millivolt Value +12) /90
-12mV~+32mV	65535×(Alarm Upper Limit Millivolt Value +12) /44	65535×(Alarm Lower Limit Millivolt Value +12) /44

Table 5.72: Calculation of LK441 Alarm Limit Value Codes

For thermocouple signals, the temperature units (Celsius or Fahrenheit) of the alarm upper and lower limits must be consistent with those adopted by the module, which can be configured by parameter "Temperature Units" with a default value of Celsius.

The alarm lower limit range is 0~65535 while its default value is 0; the alarm upper limit range is 1~65535 while its default value is 65535. The upper alarm current limit shall be higher than the lower limit, otherwise LK441 module will not be able to correctly report diagnosis information.

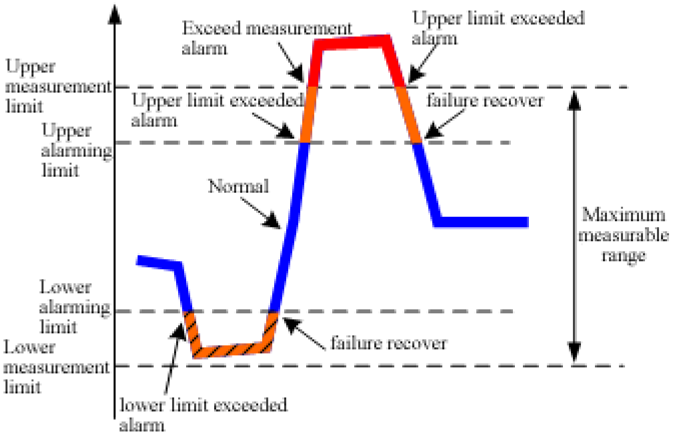


Figure 5.88: Limit Exceeded Alarm of LK441

As for different ranges set by users, the module provides different diagnosis processes of rang exceeding, as shown in Table 5.73. When signals fall back into the normal range, the channel will report diagnosis byte 0x00.

LK441 module will only report the diagnosis data once respectively when signal exceeds limits and when the failure is recovered.

Range Type	Limit Exceeding	Process of Limit Exceeded Alarm
Thermocouple	Upper Limit Exceeded	1. Channel diagnosis reports failure value 0x07 2. The channel reports the current temperature code value.
	Lower Limit Exceeded	1. Channel diagnosis reports failure value 0x08 2. The channel reports the current temperature code value.
Millivolt	Upper Limit Exceeded	1. Channel diagnosis reports failure value 0x07 2. The channel reports the current millivolt code value.
	Lower Limit Exceeded	1. Channel diagnosis reports failure value 0x08 2. The channel reports the current millivolt code value.

Table 5.73: LK441 Processes of Limit Exceeded Alarms

For ranges that support both range exceeded alarm and limit exceeded alarm, LK441 will only report the exceeding of range If the limit exceeded alarm is enabled, and the limit exceeding and range exceeding occur at the same time.

Line-Break Detection

A 10MΩ pull-up resistor is connected to the signal channel of LK441 module to detect line-break failures.

When there is line-break in an input channel, the positive-end voltage of the channel will be pulled up to +2.5V and the negative-end voltage will be pulled down to GND, then the voltage difference on the input-end of AD transfer will reach the maximum value. The channel will report "Line-Break". After the channel is reconnected, it will report "Failure Recovered".

LK441 module will only report the diagnosis data once respectively when line-break occurs and when the failure is recovered.

For thermocouple ranges, not all of them support line-break detection function. For millivolt ranges, LK441 module does not support line-break detection. *Refer to section "Optional Alarm Functions" for details.*

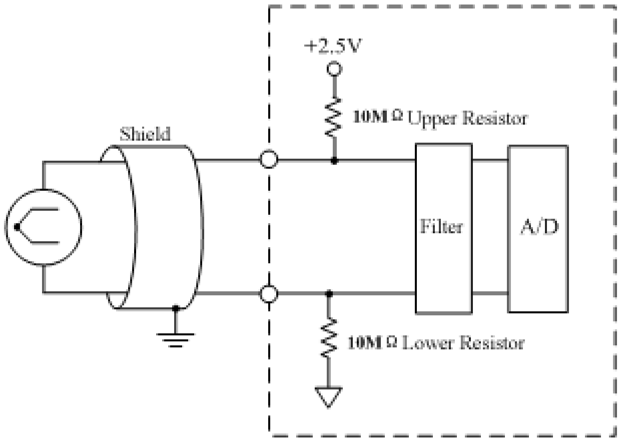


Figure 5.89: Principle of LK441 Line-Break Detection

When there is line-break of a channel's thermocouple signals:

- Channel diagnosis reports line-break failure value 0x06
- It can be configured whether the channel retains the data before line-break or report the maximum temperature value code within the measurement range.
- When the line-break is recovered, the channel diagnosis reports 0x00

When there is line-break of a channel:

- 9th Channel diagnosis (ChDiag.Module.Channel[9].Error) reports line-break failure value 0x06
- The temperature measurement channel retains the data before the break.
- When the line-break is recovered, the 9th channel diagnosis reports 0x00

5.9.8 Parameter Specifications

The controller can only read and write the I/O information regularly after it entered data exchange mode. Therefore, in order to provide correct parameter information in the initialization process, users shall first set the hardware parameters in the configuration software.

Communication Parameters

Supporting PROFIBUS-DP slave station protocol, LK441 completes data exchanges and diagnosis information reporting with the controller and other DP master stations. The slave station adopts a unique communication address, which is determined by the backplane number and the slot number of the LK441 module.

In the configuration software, the correct communication address of the slave station shall be filled in the LK441 module "DP parameter" field. Other communication parameters shall keep their default values.

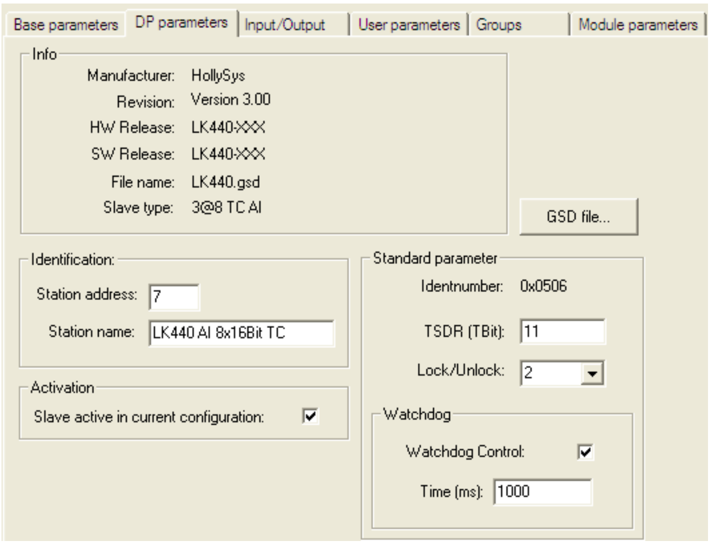


Figure 5.90: Setting of LK441 Communication Parameters

User Parameters

User parameters are used to configure the module's operating mode. They are written into the controller during the download of user program and will not be read in every scanning circle. Each parameter has a default value that can be changed according to requirements of the project. User parameters do not support online modification, therefore they can only be effective after the full download.

LK441 module has totally 49 bytes of user parameters.

Parameter Name	Parameter Definition	Parameter Value
Temperature Units	Selection of thermocouple temperature units	0: Celsius, Celsius Temperature Units (Default); 1: Fahrenheit, Fahrenheit Temperature Units
Filter Mode	Hardware Filter Mode Selection	0: No Filter, no filter, whole channel scan time 85ms; 1: 10Hz Filter, 10Hz filter, whole channel scan time 1500ms; 2: 50Hz Filter, 50Hz filter, whole channel scan time 490ms (Default); 3: 60Hz Filter, 60Hz filter, whole channel scan time 420ms; 4: 400Hz Filter, 400Hz filter, whole channel scan time 85ms;
TC Line Break Value	Selection of TC line break value reported by channel	0: Hold, report the normal value before line-break (Default); 1: Rang Maximum Value, report the range maximum value
CH1 Input Range	Range Selection of Channel 1 (The setting of "Range Selection" for individual channel would not affect others. It is allowed to have different "Range Selection" setting for different channels.)	13: "-12mV~+78mv" (Default) 14: "-12mV~+32mV" 207: B type Thermocouple, 300~1820°C 208: C type Thermocouple, 0~1725°C 209: C type Thermocouple, 0~2315°C 210: E type Thermocouple, -270~415°C 211: E type Thermocouple, -270~1000°C 212: J type Thermocouple, -210~550°C 213: J type Thermocouple, -210~1200°C 214: K type Thermocouple, -270~725°C 215: K type Thermocouple, -270~1372°C 216: N type Thermocouple, -270~840°C 217: N type Thermocouple, -270~1300°C 218: R type Thermocouple, -50~1768°C 219: S type Thermocouple, -50~1768°C 220: T type Thermocouple, -270~400°C
CH2 Input Range	Range Selection of Channel 2	
CH3 Input Range	Range Selection of Channel 3	
CH4 Input Range	Range Selection of Channel 4	
CH5 Input Range	Range Selection of Channel 5	
CH6 Input Range	Range Selection of Channel 6	
CH7 Input Range	Range Selection of Channel 7	
CH8 Input Range	Range Selection of Channel 8	
CH1 Cold End Compensation	Enable cold end compensation of CH1 (Choosing compensation type after enable "Cold End Compensation" function. There're two types: fix compensation value and connect external RTD. If using RTD type, a component type has to be chosen, either Cu50 or Pt100; if using fix compensation value type, a compensation value is required.)	0: Disable, the function is disabled (default); 1: Enable, the function is enabled.
CH2 Cold End Compensation	Enable cold end compensation of CH2	
CH2 Cold End Compensation	Enable cold end compensation of CH3	
CH4 Cold End Compensation	Enable cold end compensation of CH4	
CH5 Cold End Compensation	Enable cold end compensation of CH5	
CH6 Cold End Compensation	Enable cold end compensation of CH6	
CH7 Cold End Compensation	Enable cold end compensation of CH7	
CH8 Cold End Compensation	Enable cold end compensation of CH8	
Cold End Comp.Source	Selection of Cold End Compensation Methods	0:RTD, 9th Channel RTD Measured Cold End

		Temperature Compensation (Default) 1: Cold End Offset, Fixed Cold End Temperature Compensation
Cold End Comp.RTD Type	Selection of RTD temperature component type	0: Chinese_Cu50ohm selected (Default) 1: Pt385 100ohm selected 2: Pt3916 100ohm selected
RTD Line Break Alarm	Enable the RTD Line Break Alarm	0: Disable, the function is disabled (default); 1: Enable, the function is enabled.
Cold End Compensation Value	Fixed Cold End Temperature Compensation	Celsius Temperature Units: 0~600 (of Range 0~60ºC) Fahrenheit Temperature Units: 320~1400 (of Range 32~140°F) Compensation Value = Compensation Temperature×10, default value is 0.
CH1 Digital Filter	Software Filter Selection of Channel 1 (The setting of "Software filter Selection" for individual channel would not affect others. It is allowed to have different "Software filter Selection" setting for different channels.)	0=None, no software filter (default value) 1=3Points, filter (select 3 latest history points) 2=5Points, filter (select 5 latest history points) 3=7Points, filter (select 7 latest history points)
CH2 Digital Filter	Software Filter Selection of Channel 2	
CH3 Digital Filter	Software Filter Selection of Channel 3	
CH4 Digital Filter	Software Filter Selection of Channel 4	
CH5 Digital Filter	Software Filter Selection of Channel 5	
CH6 Digital Filter	Software Filter Selection of Channel 6	
CH7 Digital Filter	Software Filter Selection of Channel 7	
CH8 Digital Filter	Software Filter Selection of Channel 8	
CH1 Upper Limit Exceeded Alarm	Enable the Upper Limit Exceeded Alarm of Channel 1	0: Disable, the function is disabled (default); 1: Enable, the function is enabled.
CH1 Lower Limit Exceeded Alarm	Enable the Lower Limit Exceeded Alarm of Channel 1	
CH2 Upper Limit Exceeded Alarm	Enable the Upper Limit Exceeded Alarm of Channel 2	
CH2 Lower Limit Exceeded Alarm	Enable the Lower Limit Exceeded Alarm of Channel 2	
CH3 Upper Limit Exceeded Alarm	Enable the Upper Limit Exceeded Alarm of Channel 3	
CH3 Lower Limit Exceeded Alarm	Enable the Lower Limit Exceeded Alarm of Channel 3	
CH4 Upper Limit Exceeded Alarm	Enable the Upper Limit Exceeded Alarm of Channel 4	
CH4 Lower Limit Exceeded Alarm	Enable the Lower Limit Exceeded Alarm of Channel 4	
CH5 Upper Limit Exceeded Alarm	Enable the Upper Limit Exceeded Alarm of Channel 5	
CH5 Lower Limit Exceeded Alarm	Enable the Lower Limit Exceeded Alarm of Channel 5	
CH6 Upper Limit Exceeded Alarm	Enable the Upper Limit Exceeded Alarm of Channel 6	
CH6 Lower Limit Exceeded Alarm	Enable the Lower Limit Exceeded Alarm of Channel 6	
CH7 Upper Limit Exceeded Alarm	Enable the Upper Limit Exceeded Alarm of Channel 7	
CH7 Lower Limit Exceeded Alarm	Enable the Lower Limit Exceeded Alarm of Channel 7	
CH8 Upper Limit Exceeded Alarm	Enable the Upper Limit Exceeded Alarm of Channel 8	
CH8 Lower Limit Exceeded Alarm	Enable the Lower Limit Exceeded Alarm of Channel 8	
CH1 Upper Limit Value	Setting the Alarm Upper Limit Value of Channel 1	Alarm Lower Limit Range: 0(default)~65534 Alarm Upper Limit Range: 1~65535(default) Millivolt Rang 13, 14: Alarm Limit Value =65535×(millivolt value +12)/ Range, where Range =90mV for -12mV~+78mV range and Range=44mV for -12mV~+32mV range. Thermocouple Range 207~220: Alarm Limit Value = Temperature Value ×10+10000
CH1 Lower Limit Value	Setting the Alarm Lower Limit Value of Channel 1	
CH2 Upper Limit Value	Setting the Alarm Upper Limit Value of Channel 2	
CH2 Lower Limit Value	Setting the Alarm Lower Limit Value of Channel 2	
CH3Upper Limit Value	Setting the Alarm Upper Limit Value of Channel 3	
CH3 Lower Limit Value	Setting the Alarm Lower Limit Value of Channel 3	
CH4 Upper Limit Value	Setting the Alarm Upper Limit Value of Channel 4	
CH4 Lower Limit Value	Setting the Alarm Lower Limit Value of Channel 4	
CH5 Upper Limit Value	Setting the Alarm Upper Limit Value of Channel 5	
CH5 Lower Limit Value	Setting the Alarm Lower Limit Value of Channel 5	
CH6 Upper Limit Value	Setting the Alarm Upper Limit Value of Channel 6	
CH6 Lower Limit Value	Setting the Alarm Lower Limit Value of Channel 6	
CH7 Upper Limit Value	Setting the Alarm Upper Limit Value of Channel 7	

CH7 Lower Limit Value	Setting the Alarm Lower Limit Value of Channel 7	
CH8 Upper Limit Value	Setting the Alarm Upper Limit Value of Channel 8	
CH8 Lower Limit Value	Setting the Alarm Lower Limit Value of Channel 8	

Table 5.74: List of LK441 User Parameters

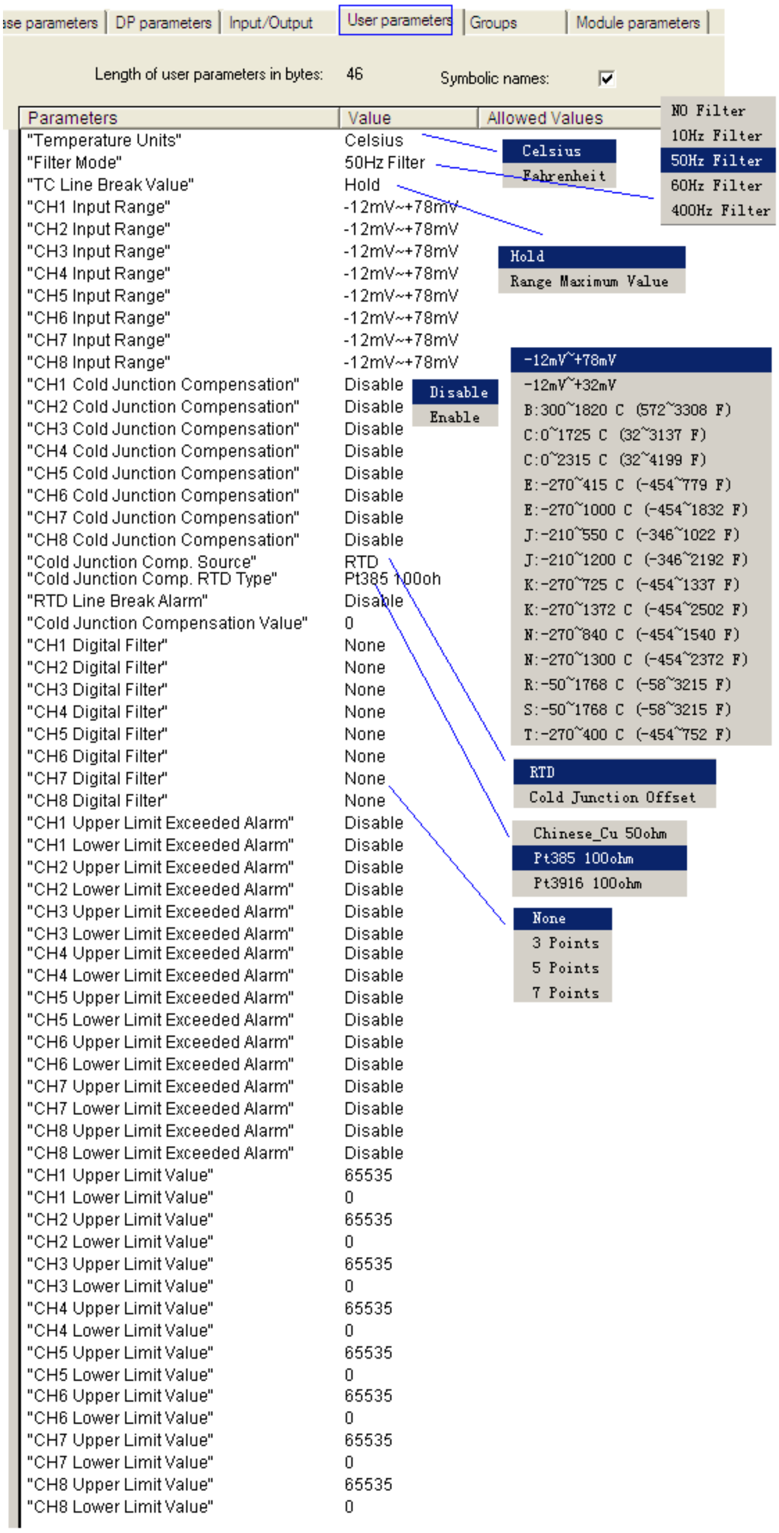


Figure 5.91: Setting of LK441 User Parameters

5.9.9 Module Installation and Un-installation

Refer to chapter 1 on "Module Insertion Mechanical keys" and "Module Insertion and Removable" for more details.

5.9.10 Technical Specification

LK441 8 Channel Thermocouple (with Cold End Compensation) AI Module		
System Power Supply		
Power Supply Voltage	24VDC(-15%~+20%)	
Power Consumption	60mA max. @24VDC	
Input Channel		
Number of Input Channels	9 (8 channels of TC or MV Signal, 1 channel of RTD Cold End Compensation)	
Signal Type	B, C, E, J, K, N, R, S, T types of Thermocouple or -12mV~+78mV / -12mV~+32mV	
Measurement Range of Thermocouple Temperature	-12mV~+78mv Range	-12mV~+32mv Range
B type		300~1820°C(572~3308°F)
C type	0~2315°C(32~4199°F)	0~1725°C(32~3137°F)
E type	-270~1000°C(-454~1832°F)	-270~415°C(-454~779°F)
J type	-210~1200°C(-346~2192°F)	-210~550°C(-346~1022°F)
K type	-270~1372°C(-454~2502°F)	-270~725°C(-454~1337°F)
N type	-270~1300°C(-454~2372°F)	-270~840°C(-454~1544°F)
R type		-50~1768°C(-58~3215°F)
S type		-50~1768°C(-58~3215°F)
T type		-270~400°C(-454~752°F)
Temperature Resolution of Thermocouple (B, C, E, J, K , N, R, S, T)	0.05°C(0.09°F)	0.03°C(0.05°F)
A/D Converter Resolution	16digit	
Voltage Measurement Precision	0.1%F.S.@ 25ºC	
Temperature Drift	±15ppm/ºC	
Differential Mode Suppression Rate	60dB	
Integral Mode Suppression Rate	100dB	
Input Impedance	10MΩmin	
Whole Channel Scanning Time	85ms, 420ms, 490ms, 1500ms, optional in configuration	
Establishment Time	1s max to enter the ±1% errors range of the full measurement range	
Channel Band-width	15Hz	
Voltage Calibration Precision	<0.04% F.S.@ 25ºC	
Calibration Period	12 months	
Isolation Voltage between Field and System	500VAC@1min, Current Leak 5mA	
Upload Data Format (0~65535)		
Millivolt Range	65535×(millivolt voltage +12)/Range	
Thermocouple Range	Measured Temperature×10+10000	
Cold End Compensation Channel		
Completion method	RTD cold end temperature acquisition	
RTD type	Chinese_Cu 50ohm, Pt385 100ohm, Pt3916 100ohm	
Temperature Precision within Operation Range (0~60°C)	Chinese_Cu 50ohm	Absolute Deviation ±1.1ºC
	Pt385 100ohm	Absolute Deviation ±0.7ºC
	Pt3916 100ohm	Absolute Deviation ±0.8ºC
Line-Break Detection	RTD Line-Break Alarm	
Failure Diagnosis and Hot swap		
Diagnosis functions		
Limit Exceeded Alarm	Signal range exceeded Alarm upper/lower limits, diagnosis byte reports 0x07/0x08	
Measurement Range Exceeded Alarm (For Limit Exceeded Alarm please refer to paragraph "Optional Alarm Functions".)	Signal exceeded range upper/lower limits, diagnosis byte reports 0x03/0x02	
Detection of Line-Break (For Line Break Alarm please refer to paragraph "Line-Break Detection".)	Line-break of channel, diagnosis reports 0x06, channel measurement data reports the full range value or the normal value before the line-break	
Cold End Compensation RTD Line-Break Detection	Line-break in RTD temperature compensation channel, the 9th channel diagnosis byte reports 0x06, the normal value before line-break will be used as the compensation value	

Hot swap	Support
Communication Bus	
protocol	PROFIBUS-DP Slave Station, in accordance with IEC61158-3/EN50170 standards
Baud Rate	Baud rate options: 1.5Mbps, 500Kbps, 187.5Kbps, 93.75Kbps, 45.45Kbps, 31.24Kbps, 19.2Kbps, 9.6Kbps
Media	Communication bus is connected to the backplane through euro connector, hot redundant communication media
Physical Features	
Mechanic Keys to Prevent Incorrect Insertion	B1
Installation Location	LK local backplane or expansion backplane
Dimension	Width × Height × Depth = 35mm×100mm×100mm
Casing Protection Level	IEC60529 IP20
Weight	180g
Working Environment	
Working Temperature	0ºC~60ºC
Working Relative Humidity	5%~95%, no condensate
Storage Temperature	-40ºC~70ºC
Storage relative Humidity	5%~95%, no condensate

Table 5.75: Technical Specification of LK441 Module

5.9.11 Appendix: Typical Value Measurement Deviation in Different Ranges

(Environment Temperature 25ºC, Measurement Errors Units in the following table: ºC)

Typical Application	Correspondence Thermocouple of -12~78mV Range							
	B	R	S	E	J	K	N	T
-200ºC				0.2	0.2	0.4	0.3	0.1
0ºC				0.1	0.4	0.2	0.2	0.1
200ºC		0.3	0.3	0.1	0.1	0.2	0.2	0.0
400ºC		0.2	0.2	0.1	0.1	0.1	0.2	0.0
600ºC	0.5	0.1	0.3	0.1	0.0	0.1	0.1	
800ºC	0.5	0.2	0.1	0.0	0.0	0.1	0.1	
1000ºC	0.3	0.2	0.4	0.0	0.0	0.2	0.1	
1200ºC	0.1	0.2	0.3		0.0	0.1	0.1	
1400ºC	0.5	0.2	0.3					
1600ºC	0.3	0.2	0.3					
1800ºC	0.3							
Typical Application	Correspondence Thermocouple of -12~32mV Range							
	B	R	S	E	J	K	N	T
-200ºC				0.2	0.2	0.4	0.3	0.1
0ºC				0.1	0.4	0.2	0.2	0.1
200ºC		0.3	0.3	0.1	0.1	0.2	0.2	0.0
400ºC		0.2	0.2	0.1	0.1	0.1	0.2	0.0
600ºC	0.5	0.1	0.3			0.1	0.1	
800ºC	0.5	0.2	0.1				0.1	
1000ºC	0.3	0.2	0.4					
1200ºC	0.1	0.2	0.3					
1400ºC	0.5	0.2	0.3					
1600ºC	0.3	0.2	0.3					
1800ºC	0.3							

Table 5.76: LK 441 Typical Value Measurement Deviation in Different Ranges

Chapter 6

CHAPTER 6: ANALOG OUTPUT MODULE

6.1 LK510 [4-CHANNEL INTER-CHANNEL ISOLATION VOLTAGE AO MODULE]

6.1.1 Features

- 4 channels of voltage outputs, inter-channel isolation
- Output voltage: 0~5.125V/0~10.25V/±10.25V
- Programming mode output
- Communication failure output
- Output over-current protection
- Detection of calibration data errors
- Field Power Supply Loss Detection
- Support ProfiBus-DP slave station protocol
- System-to-Field Isolation
- Supports hot swap

6.1.2 Operation Principles

The controller transmits the output data through PROFIBUS-DP bus to LK510, where they are converted into voltage signals by DAC conversion. The driver circuit of the module receives the voltage signal from DAC and output them after adjustment and amplification to control acuter operations on the field.

Output channels are isolated from each other. A 24V DC power separately supplies each channel through isolated DC/DC conversion. Meanwhile, interface circuit of each channel is connected to other circuit through optical couples to enable the isolation between the field and the system.

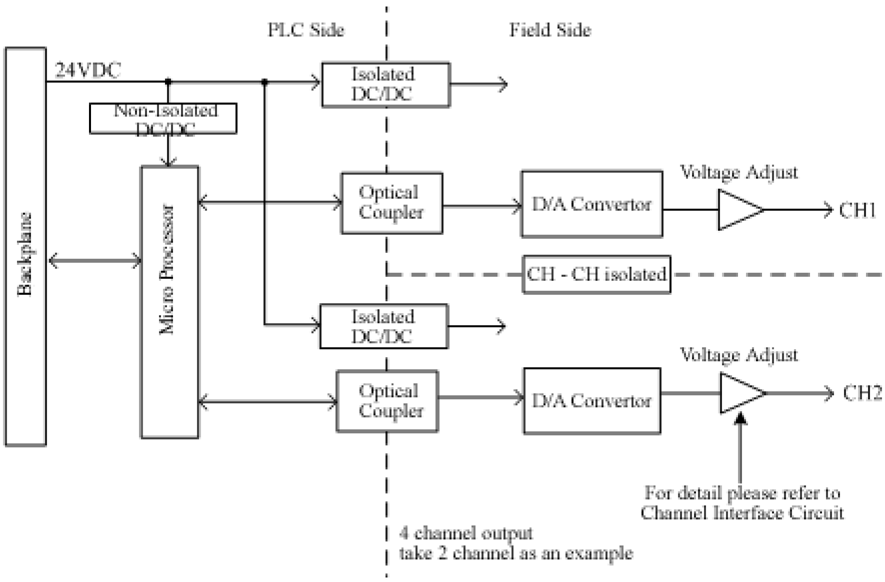


Figure 6.1: Internal Structure of LK510 Module

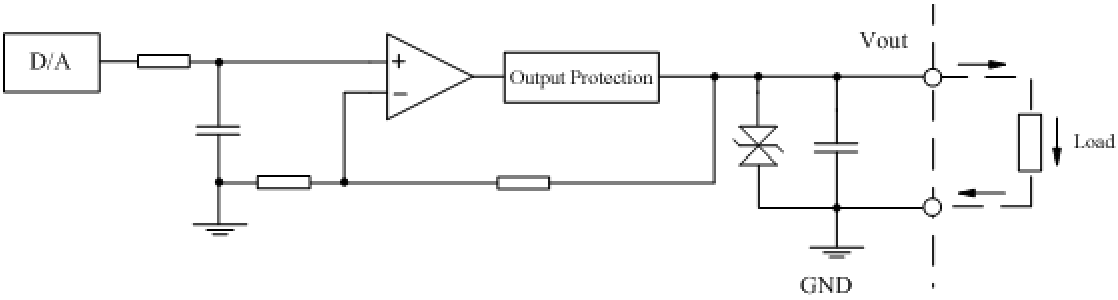


Figure 6.2: LK 510 Channel Interface Circuit

6.1.3 Indicators Definition

Refer to section 5.1.1: The LED Status indicator

6.1.4 Wiring Specifications

LK510 module is installed on LK series backplanes that support two types of wirings: terminal wiring and prefabricated cable wiring.

Wiring to Backplane Terminals

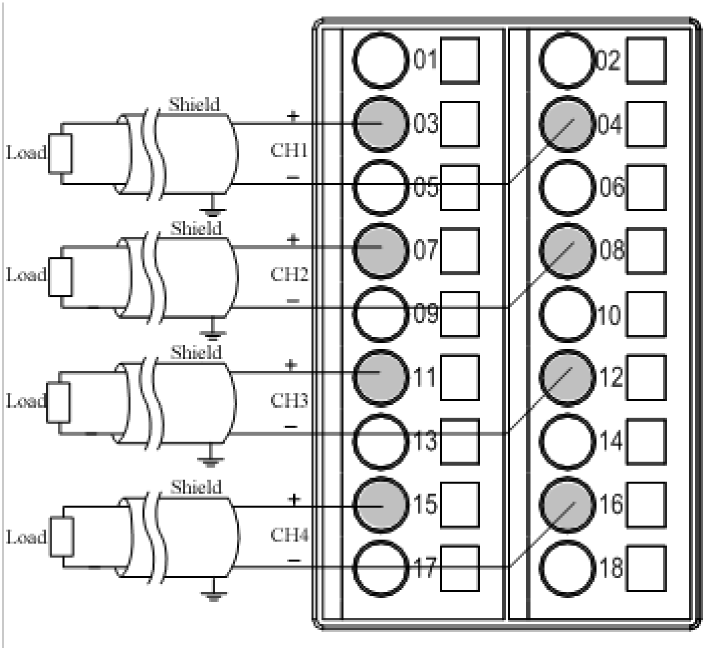


Figure 6.3: Wiring of LK510 Backplane Terminals

LK510 module is connected to field signals through the correspondence terminals under the backplane installation slot. The relationship between each channel and terminal is shown in Figure 6.3. In the wiring, the following shall be noted:

- Each channel of the AO signals of the field is connected to its respective terminal through two (shielded) cables.
- The odd-number terminals connect to voltage positive ends while the even-number terminals connect to voltage negative ends.
- The un-wired terminals in the figure shall not be wired in actual application.
- A single terminal shall not be connected to many wires; therefore multiple-point connection can be established through bus bar or transferring terminal board.

Wiring to Terminal Modules

Please refer to the information found on Chapter 12: Terminal Module.

6.1.5 Function Specifications

Data Format

As shown in Table 6.1, the AO channel output data that transmitted from the controller to LK510 are represented by 2 bytes of positive integer numbers (decimal 0~65535). Among which, two segments are divided in the measurement range (-10.25~+10.25V) , the positive voltage (0~10.25V) signals are represented by decimal code value range 0~32767 while the negative voltage (-10.25~0V) signals by decimal code value range 32768~65535.

Output Range		Decimal Code Value
-10.25~+10.25V	0~10.25V	0~32767
	-10.25V~0V	32768~65535
0~10.25V		0~65535
0~5.125V		0~65535

Table 6.1: The Corresponding Relation of LK510 Output Voltage and the Decimal Code

The output data of the range (-10.25~+10.25) can be converted to their corresponding codes by the following equation:

- Positive voltage 0~+10.25: Voltage Value (V) = output data/32767×10.25
- Negative Voltage -10.25~0V: Voltage Value (V) = (output data -65535)/32767×10.25

The function block HS_HEX_ENGIN in the analog conversion library HS_AnalogConvert.lib of the configuration software PowerPro V4 can be called to convert the engineering data into the 2bytes code values that will be sent to the output channels. (Field Side signal that being measured include pressure, temperature and voltage etc. After user defines the upper and lower limit of engineer units, function block will output the corresponding value according to the measurement value automatically.)

For detailed usage of the function block, please refer to LK Series PLC - Instruction Manual.

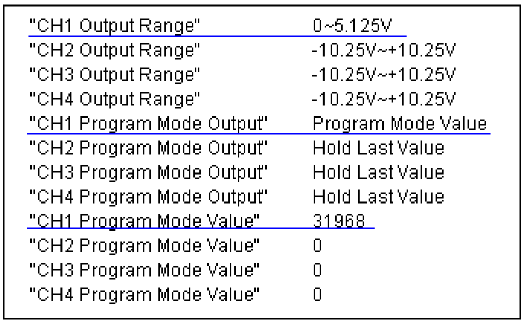
To configure the Fault Mode Set Value and Programming Mode Set Value in user parameters, the voltage signals shall be filled in after converted into decimal machine codes. For different ranges, the machine code conversion methods are different.

For the ranges of 0~10.25V and 0~5.125V, the Signal conversion equation is as follow:

*Machine Code Value = Voltage Signal×65535/Full Range Value**

**Full Range value equal to maximum measurable value minus minimum measurable value.*

Take channel 1 for example, if its range is set to "0~10.25V" and the user-defined programming mode output is 5V, then the Full-range Voltage=10.25V while the Programming Mode Set Value=5×65535/10.25=31968. The user parameter configuration is as shown in Figure 6.4.



"CH1 Output Range"	0~5.125V
"CH2 Output Range"	-10.25V~+10.25V
"CH3 Output Range"	-10.25V~+10.25V
"CH4 Output Range"	-10.25V~+10.25V
"CH1 Program Mode Output"	Program Mode Value
"CH2 Program Mode Output"	Hold Last Value
"CH3 Program Mode Output"	Hold Last Value
"CH4 Program Mode Output"	Hold Last Value
"CH1 Program Mode Value"	31968
"CH2 Program Mode Value"	0
"CH3 Program Mode Value"	0
"CH4 Program Mode Value"	0

Figure 6.4: Programming Mode Parameter Setting Example in Set Range

For the ranges of -10.25~+10.25V, the Signal conversion equation is as follow:

- **Positive Voltage Range (0~10.25):** Machine Code Value = Positive Voltage Signal ×32767/10.25
- **Negative Voltage Range (-10.25~0V):** Machine Code Value = 65535 + (Negative Voltage Signal ×32767/10.25)

Take Channel 3 for example, if its range is set as "-10.25~+10.25V" and the user-defined fault mode output is -9V, then the Fault Mode Value=65535+（-9×32767/10.25)V=36764. *Refer to Figure 6.5 for user parameter configuration.*

"CH1 Output Range"	-10.25V~+10.25V
"CH2 Output Range"	-10.25V~+10.25V
"CH3 Output Range"	-10.25V~+10.25V
"CH4 Output Range"	-10.25V~+10.25V
"CH1 Fault Mode Output"	Hold Last Value
"CH2 Fault Mode Output"	Hold Last Value
"CH3 Fault Mode Output"	Fault Mode Value
"CH4 Fault Mode Output"	Hold Last Value
"CH1 Fault Mode Value"	0
"CH2 Fault Mode Value"	0
"CH3 Fault Mode Value"	36764
"CH4 Fault Mode Value"	0

Figure 6.5: Limit Exceeded Alarm Parameter Setting in Set Range

Enable Output

After the output module is power on, if it does not receive any output instruction from the controller, it will keep the initial status and does no output. The output of an initial status module is disabled. In this case, the module will keep this initial status even it enters programming mode or fault mode.

After the operation of user programs, the controller sends output instruction to the output module through PROFIBUS-DP bus. Output module receives instruction and outputs data. The output of a slave module is enable once the module outputs an instruction sent by the controller. When the module output is enable, in case the module enters programming mode or fault mode, it will output values of programming mode or fault mode.

In short, whether the module output is enabled will affect its output status under fault mode and programming mode.

If the module is hot-swamped or turned on again after power loss after its output is enable, it will return back to the initial status and the output is disabled again. The output will be enabled again once the module receives another output instruction from the controller.

After a full-download, the user program in the controller stops operation and the slave module enters programming mode automatically. In this case, if the module output is enabled before the download, it will output the programming mode value; if the module output is disabled before the download, it will keep the initial status.

After the full-download, the user program operation can be executed through the following two methods:

- Turn the key switch on controller front-panel to “RUN”.
- Turn the key switch on controller front-panel to “REM” and execute “Operation” command in the programming software.

Over-Current Protection

Output channels provide over-current protection function. When short-circuit occurs in output, the maximum output current of the channel is smaller than 25mA to effectively protect the module internal circuits from any damages.

Programming Mode

Programming mode is a working mode of the controller to modify, edit and download user programs. In programming mode, user programs are halted and cannot be restarted through programming software. Not under control, output module retains output or outputs a value preset in the configuration, known as the Program Mode Value.

Controller can make the slave station into or out of programming mode through the following methods:

- Turn the key switch to “PRG” to force all modules into programming mode. Then, operation of user program halts, LK510 outputs program mode value.
- Turn the key switch to “RUN”, module gets out of programming mode and controller run the user program.

Please note the if the module has never been output enabled; it does not output programming mode value even it enters programming mode.

After the full-download of user program, output module automatically enters programming mode no matter whether the controller key switch is located at “PRG”. If the output module has never output any data before the download (e.g. output is not enabled), it will retain the initial status and does not output. If the module output has been enabled before the download, module outputs programming mode value.

Under programming mode, whether the module retains output or outputs programming mode value is configure by user parameter “Program Mode Output”, default value of which is “Hold Last Value”. Programming mode value is configured by user parameter “Program Mode value”, default output of which is 0V. *Refer to section “Data Format” for the calculation method of the programming mode value*.

Parameters of each channel are configured separately without interfere to others. Modifications will only be effective after the full download. Special notes shall be taken that: after the full down and before the operation, the module is under programming mode and outputs previous programming mode value. The new value will only replace the previous one after the operation of user program.

After the full download, LK510 enters programming mode automatically. If user program does not start operation, and module does not receive any data sent by the controller after several seconds waiting, it automatically gets offline and enters fault mode with its RUN light flashing. The module will automatically reset and re-establish communication with its RUN light constantly on again. Then the module will wait another few seconds and if there is still no data, it will get offline and enter fault mode again. This process will be cycled till the user program starts running and the module outputs normally.

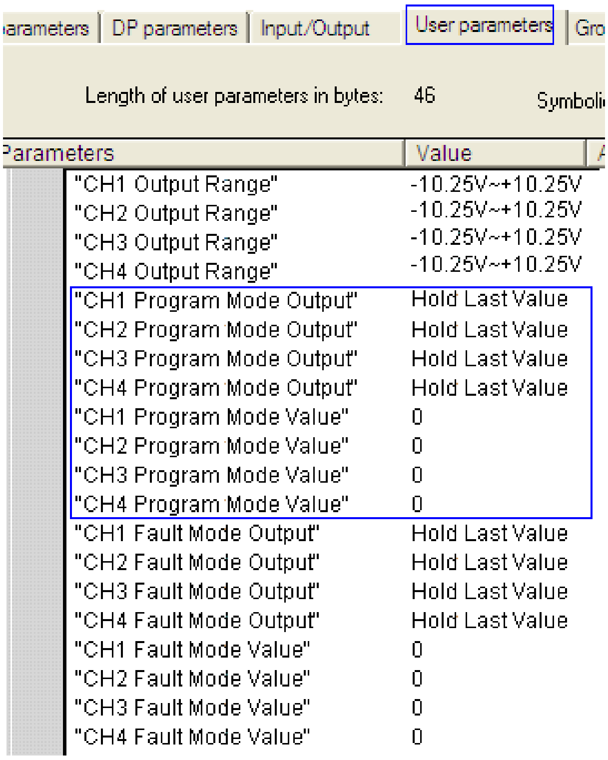


Figure 6.6: LK510 Output Setting under Programming Mode

Communication Failure

When communication failure occurs, the communication between controller and output module breaks and the “RUN” light flashes. The module may be in one of the following states in communication failure:

After power on, module cannot establish communication with the controller, then the module will retain the initial status and its output is not enabled.

Module in operation when communication failure occurs: module retains output or outputs a value preset in the configuration, known as the Fault Mode Value. Whether the module retains output or outputs fault mode value can be configured in software.

Module in programming mode when communication failure occurs: module enters fault mode and outputs fault mode value. When failure recovered, module returns to programming mode automatically and outputs programming mode value again.

If the module output has not been enabled, the module does not output fault mode value even if any communication failure occurs.

Under fault mode, whether the module retains output or outputs fault mode value is configure by user parameter "Fault Mode Output", default value of which is "Hold Last Value". Fault mode value is configured by user parameter "Fault Mode value", default output of which is 0V. Parameters of each channel are configured separately without interfere to others.

Refer to section "Data Format" for the calculation method of the fault mode value.

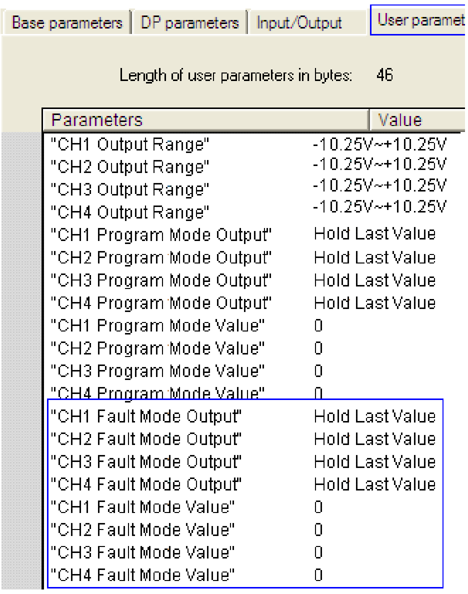


Figure 6.7: LK510 Fault Mode Value Setting

6.1.6 Specifications of Diagnosis

PowerPro V4 configuration software adopts external diagnosis library to check and acquire all kinds of diagnosis information, such as whether the module and its channels are operating normally, whether the field power supplying smoothly and whether the module parameters are set correctly.

For the DP slave station modules, the DP slave station expansion diagnosis function block (HS_DPSlaveALarm) shall be called to check the DP module at any address (DP_Addr) on the PROFIBUS-DP link, as shown in Figure 6.8.

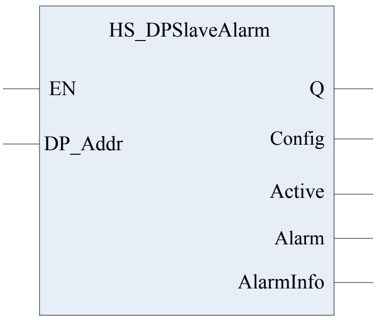


Figure 6.8: Expansion Diagnosis Function Block for DP Slave Station

For detailed usage of DP Expansion Diagnosis Function Block, please refer to LK Large Scale PLC Instruction Manual. Users shall note that the Diagnosis library is an external library that shall be first installed in the Library Manager before use.

The diagnosis information of DP slave station modules can be classified to 3 categories: device diagnosis, identifier diagnosis and channel diagnosis. All diagnosis data exist in the form of block structure.

- **Device Diagnosis:** records of the overall diagnosis information of the module, such as, power loss of field power supply.
- **Module Diagnosis:** records of whether the module has diagnosis information.
- **Channel Diagnosis:** records of the channel level diagnosis information, such as line break and range exceeding.

Calibration Data Error Diagnosis

Calibration data error diagnosis is a kind of device diagnoses. After power on, the module reads the calibration data in the storage. In the reading, if there is any error of the calibration data, the device diagnosis data area will generate a diagnosis byte "0x02" (Bit=1 in diagnosis byte) and report it to the controller.

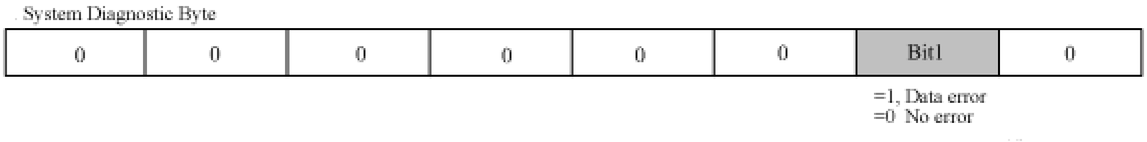


Figure 6.9: Device Diagnosis Byte of LK510 Module

After the DP slave station expansion diagnosis function block (HS_DPSlaveAlarm) is called, the device diagnosis data reported by LK510 will be stored in the corresponding fields of the output parameter "AlarmInfo", as shown in Table 6.2.

Diagnosis Information		Value	Definition
Device Diagnosis	ALarmInfo.DevDiag.Data[1]	0X02	Calibration Data Error
		0x00	No Error in Calibration Data

Table 6.2: Definition of LK510 Diagnosis Information

When error occurs in calibration data, the output voltage then may not meet the precision requirement. The module shall be re-swamped or re-calibrated. If the calibration error persists, the module shall be changed.

The diagnosis of calibration data error will only be executed when the module is just turn on. This diagnosis will not be carried out when module begins its normal operation.

6.1.7 Parameter Specifications

The controller can only read and write the high-speed I/O information regularly after it entered data exchange mode. Therefore, in order to provide correct parameter information in the initialization process, users shall first set the parameters in the configuration software.

Communication Parameters

Supporting PROFIBUS-DP slave station protocol, LK510 completes data exchanges and diagnosis information reporting with the controller and other DP master stations. The slave station adopts a unique communication address, which is determined by the backplane number and the slot number of the LK510 module.

Refer to Chapter 2: Backplanes for the allocation of communication address.

As shown in Figure 6.10, the communication address of LK510 module shall be filled into the field "Station Address".

If modules have been added or deleted in the configuration software, or the slot number of module on the backplane has been changed, the communication address in "DP Parameter" shall be check to ensure the accuracy.

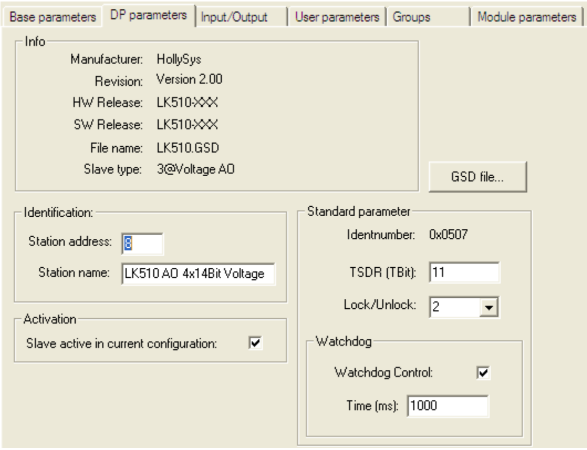


Figure 6.10: Setting of LK510 Communication Parameters

User Parameters

User parameters are used to configure the module's operating mode. They are written into the controller during the download of user program and will not be read in every scanning circle. Each parameter has a default value that can be changed according to requirements of the project. User parameters do not support online modification; therefore they can only be effective after the full download.

LK510 has total 21 bytes of user parameters.

Parameter Name	Parameter Definition	Value Options
CH1 Output Range	Range Selection of Channel 1	16: -10.25~+10.25V (Default); 17: 0~10.25V 18: 0~5.125V
CH2 Output Range	Range Selection of Channel 2	
CH3 Output Range	Range Selection of Channel 3	
CH4 Output Range	Range Selection of Channel 4	
CH1 Program Mode Output	Selection of Channel 1 Programming Mode Output	0: Hold Last Value, retains output (default) 1: Programming Mode value, outputs programming mode value
CH2 Program Mode Output	Selection of Channel 2 Programming Mode Output	
CH3 Program Mode Output	Selection of Channel 3 Programming Mode Output	
CH4 Program Mode Output	Selection of Channel 4 Programming Mode Output	
CH1 Program Mode Value	Programming Mode Value of Channel 1	0 (Default) ~65535 *Refer to section "Data Format" for the calculation.*
CH2 Program Mode Value	Programming Mode Value of Channel 2	
CH3 Program Mode Value	Programming Mode Value of Channel 3	
CH4 Program Mode Value	Programming Mode Value of Channel 4	
CH1 Fault Mode Output	Selection of Channel 1 Fault Mode Output	0: Hold Last Value, retains output (default) 1: Fault Mode value, outputs fault mode value
CH2 Fault Mode Output	Selection of Channel 2 Fault Mode Output	
CH3 Fault Mode Output	Selection of Channel 3 Fault Mode Output	
CH4 Fault Mode Output	Selection of Channel 4 Fault Mode Output	
CH1 Fault Mode Value	Fault Mode Value of Channel 1	0 (Default) ~65535 *Refer to section "Data Format" for the calculation.*
CH2 Fault Mode Value	Fault Mode Value of Channel 2	
CH3 Fault Mode Value	Fault Mode Value of Channel 3	
CH4 Fault Mode Value	Fault Mode Value of Channel 4	

Figure 6.11: List of LK510 User Parameters

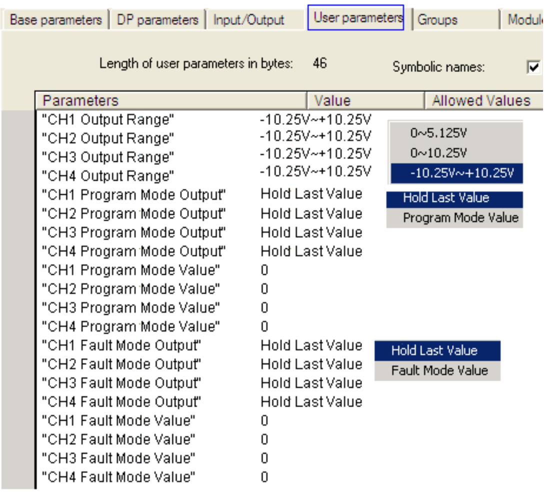


Figure 6.12: Setting of LK510 User Parameters

6.1.8 Module Installation and Un-installation

Refer to chapter 1 on "Module Insertion Mechanical keys" and "Module Insertion and Removable" for more details.

6.1.9 Technical Specification

LK510 4-Channel Inter-Channel Isolation Voltage AO Module				
Backplane Power Supply				
Power Supply Voltage	24VDC(-15%~+20%)			
Power Consumption	125mA max. @24VDC			
Output Channel				
Number of Channels	4			
Range Code.	18	17	16	
Measurement Range	0~5.125V	0~10.25V	-10.25~0V	0~+10.25V
Output Data Format	0~ 65535	0~65535	32768~65535	0~32767
Establishment Time	<2ms			
DAC Resolution	14digit			
Load Capacity	≥2KΩ			
Power-on Reset Output (Cold Reset)	0V			
Hot Reset Output (Hot Reset)	Retain the output before the reset			
Output Precision	0.2%F.S.			
Stability	0.05%F.S.			
Temperature Drift	25ppm/ºC			
Isolation Voltage				
Field to System	500V AC 1min Testing, Current Leak 5mA			
Channel to Channel	500V AC 1min Testing, Current Leak 5mA			
Failure Diagnosis				
Calibration Data Error Diagnosis	After power on, module calibrates data errors, device diagnosis byte reports 0x02, no report when there is no error			
Communication				
protocol	ProfiBus-DP			
Redundancy	Dual Network Redundancy			
Baud Rate	9.6Kbps, 19.2Kbps, 31.25Kbps, 45.45Kbps, 93.75Kbps, 187. 5Kbps, 500Kbps, 1.5Mbps			
Physical Features				
Installation	Installation on backplane slot			
Installation Location	LK local backplane or expansion backplane			
Mechanic Keys to Prevent Incorrect Insertion	C0			
Dimension	(Width× Height ×Depth) 35mm×100mm×100m			
Hot swap	Support			
Casing Protection Level	IEC60529 IP20			
Weight	180g			
Working Environment				
Working Temperature	0ºC~60ºC			
Working Relative Humidity	5%~95%, no condensate			
Storage Temperature	-40ºC~70ºC			
Storage relative Humidity	5%~95%, no condensate			

Table 6.3: Technical Specification of LK510 Module

6.2 LK511 [4-CHANNEL INTER-CHANNEL ISOLATION CURRENT AO MODULE]

6.2.1 Features

- 4 channels of current outputs, inter-channel isolation
- Output Signal Range: 4~20mA/0~21mA
- Electric Isolation between Channel and System
- Support ProfiBus-DP slave station protocol
- Calibration on Field
- Fault Mode Output
- Programming mode output
- Output Read-back Channel Self-Diagnosis
- Line-Break Detection
- Supports hot swap

6.2.2 Operation Principles

The controller transmits the output data through PROFIBUS-DP bus to LK511, where they are converted into voltage signals by DAC conversion. The driver circuit of the module receives the voltage signal from DAC and output them after voltage-current conversion, adjustment and amplification to control acuter operations on the field.

Output channels are isolated from each other. A 24V DC power separately supplies each channel through isolated DC/DC conversion. Meanwhile, interface circuit of each channel is connected to other circuit through optical couples to enable the isolation between the field and the system.

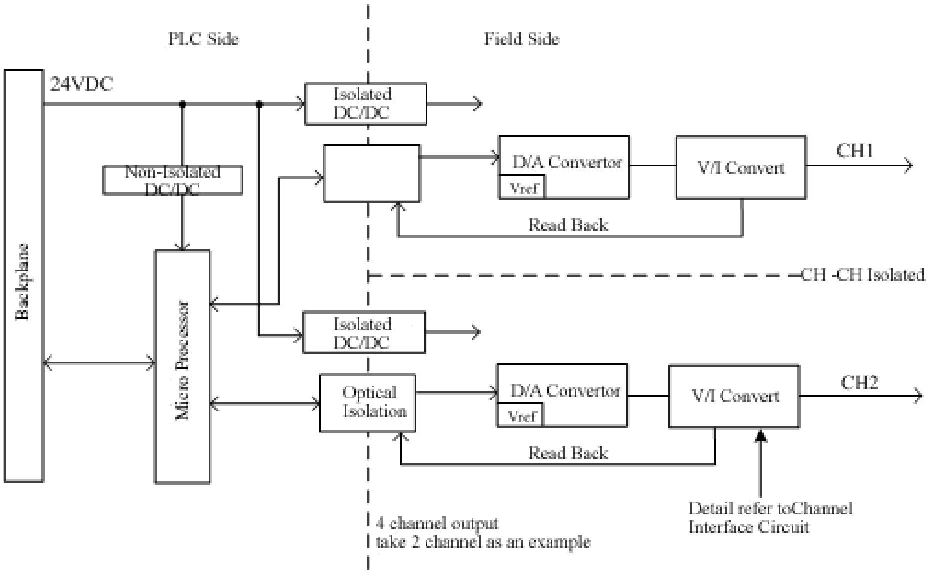


Figure 6.13: Internal Structure of LK511 Module

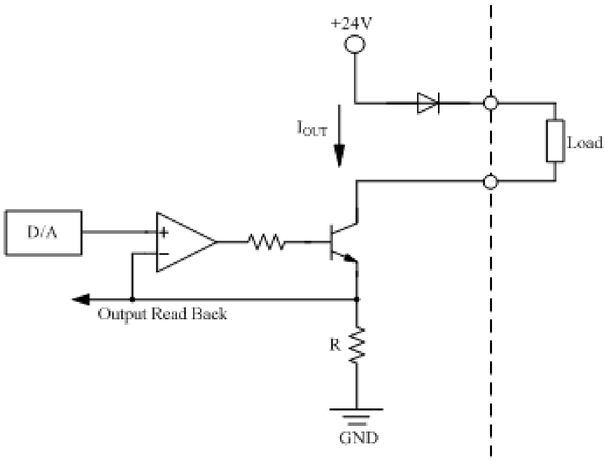


Figure 6.14: LK 511 Channel Interface Circuit

6.2.3 Indicators Definition

Refer to section 5.1.1: The LED Status indicator

6.2.4 Wiring Specifications

LK511 module is installed on LK series backplanes that support two types of wirings: terminal wiring and prefabricated cable wring.

Wiring to Backplane Terminals

Channel Number	Terminal Number	
	Current Input Terminal	Current Output Terminal
1	01	02
2	05	06
3	09	10
4	13	14

Table 6.4: Definitions of LK511 Backplane Wiring Terminals

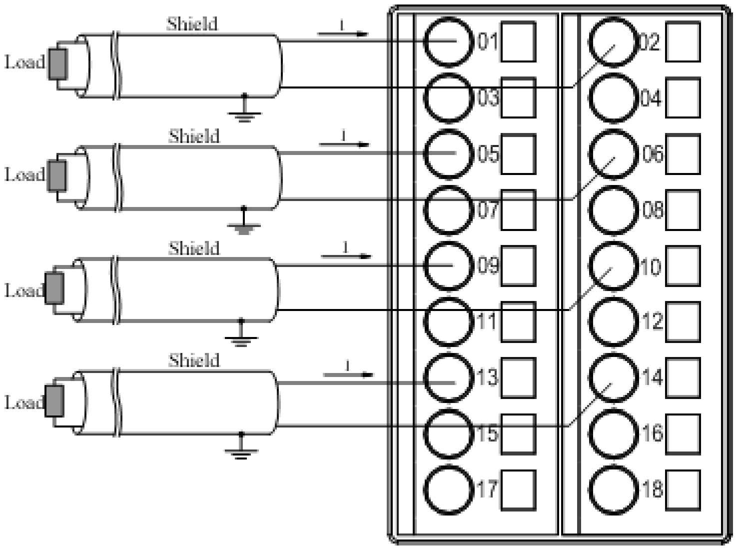


Figure 6.15: Wiring of LK511 Backplane Terminals

In the wiring, the following shall be noted:

- The 18digit double wiring terminals shall be installed on the backplane, right under the installation slot of LK511 module.
- Strictly no wiring for terminals not listed in the table above.
- Among its 4 channels of current analog output, only the 4 pairs terminals in Figure 6.15 shall be used in actual wiring while strictly no wiring on other terminals
- Each channel of the AO signals is connected to field devices through two (shielded) cables.
- After wiring, cable connections shall be checked to ensure the correct wiring. In order to avoid dangers such as short circuit, there shall be no nude cable outside of the terminals.

Wiring to Terminal Modules

Please refer to the information found on Chapter 12: Terminal Module.

6.2.5 Function Specifications

Data Format

As shown in Table 6.5, the output data that sent by the controller to LK511 AO channels are represented by 2byte positive integer codes (decimal value range 0~65535).

Output Range	Decimal Code Value
4~20mA	0~65535
0~21mA	0~65535

Table 6.5: The Corresponding Relation of LK511 Output Voltage and the Decimal Code

The function block HS_HEX_ENGIN in the analog conversion library HS_AnalogConvert.lib of the configuration software Powerpro V4 can be called to convert the engineering data into the 2bytes code values

that will be sent to the output channels. (Field Side signal that being measured include pressure, temperature and voltage etc. Once user defines the upper and lower limit of engineer units, function block will output the corresponding value according to the measurement value automatically.)

For detailed usage of the function block, please refer to LK Series PLC - Instruction Manual.

To configure the Fault Mode Value and Programming Mode Value in user parameters, the current signals shall be filled in after converted into decimal machine codes.

For the ranges of 4~20mA, the signal and code value conversion equation is as follow:

➢ Code Value = (Current Signal - 4) × 65535/16

Take channel 1 for example, if its range is set to "4~20mA" and the user-defined programming mode output is 15mA, then the Output Programming Mode Value=(15-4)×65535/116=45055. The user parameter configuration is as shown in Figure 6.16.

"CH1 Output Range"	4~20mA
"CH2 Output Range"	4~20mA
"CH3 Output Range"	4~20mA
"CH4 Output Range"	4~20mA
"CH1 Program Mode Output"	Program Mode Value
"CH2 Program Mode Output"	Hold Last Value
"CH3 Program Mode Output"	Hold Last Value
"CH4 Program Mode Output"	Hold Last Value
"CH1 Program Mode Value"	45055
"CH2 Program Mode Value"	0
"CH3 Program Mode Value"	0
"CH4 Program Mode Value"	0

Figure 6.16: Programming Mode Parameter Setting Example in Set Range

For the ranges of 0~21mA, the Signal conversion equation is as follow:

➢ Code Value = Current Signal × 65535/21

Take Channel 3 for example, if its range is set as "0~21mA" and the user-defined fault mode output is 4mA, then the Output Fault Mode Value=4×65535/21=12483. Refer to Figure 6.17 for user parameter configuration.

"CH1 Output Range"	4~20mA
"CH2 Output Range"	4~20mA
"CH3 Output Range"	0~21mA
"CH4 Output Range"	4~20mA
"CH1 Fault Mode Output"	Hold Last Value
"CH2 Fault Mode Output"	Hold Last Value
"CH3 Fault Mode Output"	Fault Mode Value
"CH4 Fault Mode Output"	Hold Last Value
"CH1 Fault Mode Value"	0
"CH2 Fault Mode Value"	0
"CH3 Fault Mode Value"	12483
"CH4 Fault Mode Value"	0

Figure 6.17: Limit Exceeded Alarm Parameter Setting Example in Set Range

Enable Output

After the output module is power on, if it does not receive any output instruction from the controller, it will keep the initial mode and does no output. The output of an initial mode module is disabled. In this case, the module will keep this initial mode even it enters programming mode or failure mode.

After the operation of user programs, the controller sends output instruction to the output module through PROFIBUS-DP bus. Output module receives instruction and outputs data. The output of a slave module is enabled once the module outputs an instruction sent by the controller. When the module output is enable, in case the module enters programming mode or failure mode, it will output values of programming mode or failure mode.

In short, whether the module output is enabled will affect its output status under failure mode and programming mode.

If the module is hot-swamped or turned on again after power loss after its output is enable, it will return back to the initial status and the output is disabled again. The output will be enabled again once the module receives another output instruction from the controller.

After a full-download, the user program in the controller stops operation and the slave module enters programming mode automatically. In this case, if the module output is enabled before the download, it will output the programming mode value; if the module output is disabled before the download, it will keep the initial status.

After the full-download, the user program operation can be executed through the following two methods:

- Turn the key switch on controller front-panel to “RUN”.
- Turn the key switch on controller front-panel to “REM” and execute “Operation” command in the programming software.

Programming Mode

Programming mode is a working mode of the controller to modify, edit and download user programs. In programming mode, user programs are halted and cannot be restarted through programming software. Not under control, output module retains output or outputs a value preset in the configuration, known as the Program Mode Value.

Controller can make the slave station into or out of programming mode through the following methods:

- Turn the key switch to “PRG” to force all output modules into programming mode. Then, operation of user program halts, LK511 outputs program mode value.
- Turn the key switch to “RUN”, module gets out of programming mode and controller run the user program.

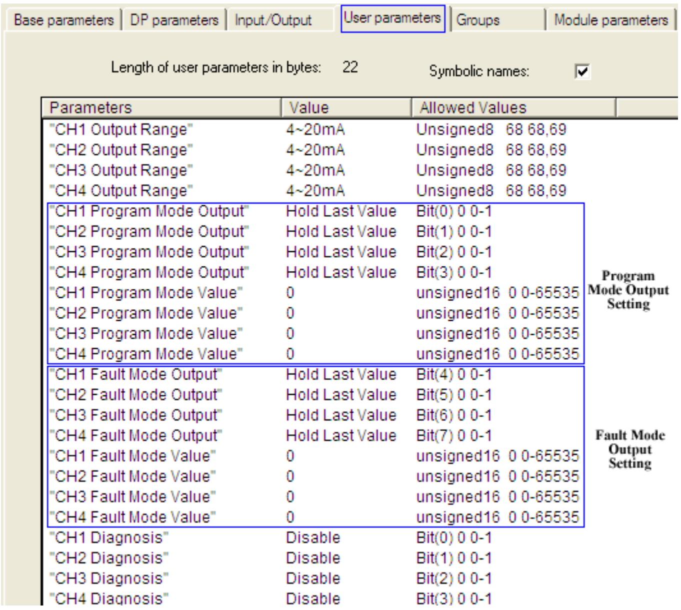
Please note, if the module output has never been enabled; it does not output programming mode value even it enters programming mode.

After the full-download of user program, output module automatically enters programming mode no matter whether the controller key switch is located at “PRG”. If the output module has never output any data before the download (e.g. output is not enabled), it will retain the initial status and does not output. If the module output has been enabled before the download, module outputs programming mode value.

Under programming mode, whether the module retains output or outputs programming mode value is configure by user parameter “Program Mode Output”, whose default value is “Hold Last Value”. Programming mode value is configured by user parameter “Program Mode value”, default output of which is 0 (Range 4~20mA, Code Value:0 Corresponding output:4mA; Range 0~21mA, Code Value:0 Corresponding output:0mA.)

Refer to section on “Data Format” for the calculation method of the programming mode value.

Parameters of each channel are configured separately without interfere to others. Modifications will only be effective after the full download Special notes shall be taken that: after the full down and before the operation, the module is under programming mode and outputs previous programming mode value. The new value will only replace the previous one after the operation of user program.



Parameters	Value	Allowed Values
"CH1 Output Range"	4~20mA	Unsigned8 68 68,69
"CH2 Output Range"	4~20mA	Unsigned8 68 68,69
"CH3 Output Range"	4~20mA	Unsigned8 68 68,69
"CH4 Output Range"	4~20mA	Unsigned8 68 68,69
"CH1 Program Mode Output"	Hold Last Value	Bit(0) 0 0-1
"CH2 Program Mode Output"	Hold Last Value	Bit(1) 0 0-1
"CH3 Program Mode Output"	Hold Last Value	Bit(2) 0 0-1
"CH4 Program Mode Output"	Hold Last Value	Bit(3) 0 0-1
"CH1 Program Mode Value"	0	unsigned16 0 0-65535
"CH2 Program Mode Value"	0	unsigned16 0 0-65535
"CH3 Program Mode Value"	0	unsigned16 0 0-65535
"CH4 Program Mode Value"	0	unsigned16 0 0-65535
"CH1 Fault Mode Output"	Hold Last Value	Bit(4) 0 0-1
"CH2 Fault Mode Output"	Hold Last Value	Bit(5) 0 0-1
"CH3 Fault Mode Output"	Hold Last Value	Bit(6) 0 0-1
"CH4 Fault Mode Output"	Hold Last Value	Bit(7) 0 0-1
"CH1 Fault Mode Value"	0	unsigned16 0 0-65535
"CH2 Fault Mode Value"	0	unsigned16 0 0-65535
"CH3 Fault Mode Value"	0	unsigned16 0 0-65535
"CH4 Fault Mode Value"	0	unsigned16 0 0-65535
"CH1 Diagnosis"	Disable	Bit(0) 0 0-1
"CH2 Diagnosis"	Disable	Bit(1) 0 0-1
"CH3 Diagnosis"	Disable	Bit(2) 0 0-1
"CH4 Diagnosis"	Disable	Bit(3) 0 0-1

Figure 6.18: LK511 Parameters of Programming Mode and Fault Mode

Communication Failure

When communication failure occurs, the communication between controller and output module breaks and the "RUN" light flashes. The module may be in one of the following states in communication failure:

After power on, module cannot establish communication with the controller, then the module will retain the initial status and its output is not enabled.

Module in operation when communication failure occurs: module retains output or outputs a value preset in the configuration, known as the Fault mode value. Whether the module retains output or outputs fault mode value can be configured in software.

Module in programming mode when communication failure occurs: module enters fault mode and outputs fault mode value. When failure recovered, module returns to programming mode automatically and outputs programming mode value again.

If the module output has not been enabled, the module does not output fault mode value even if any communication failure occurs.

Under fault mode, whether the module retains output or outputs fault mode value is configure by user parameter "Fault Mode Output", default value of which is "Hold Last Value". Programming mode value is configured by user parameter "Fault Mode Value", default output of which is 0. (Range 4~20mA, Code Value:0 Corresponding output 4mA; Range 0~21mA, Code Value:0 Corresponding output: 0mA.)

Refer to section on "Data Format" for the calculation method of the fault mode value.

Parameters of each channel are configured separately without interfere to others.

6.2.6 Specifications of Diagnosis

PowerPro V4 configuration software adopts external diagnosis library to check and acquire all kinds of diagnosis information, such as whether the module and its channels are operating normally, whether the field power supplying smoothly and whether the module parameters are set correctly.

For the DP slave station modules, the DP slave station expansion diagnosis function block (HS_DPSlaveALarm) shall be called to check the DP module at any address (DP_Addr) on the PROFIBUS-DP link, as shown in Figure 6.19.

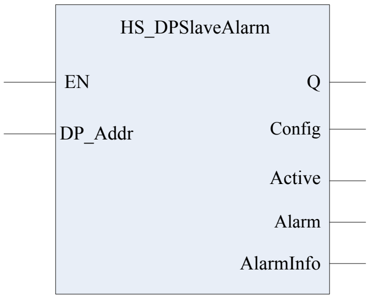


Figure 6.19: Expansion Diagnosis Function Block for DP Slave Station

For detailed usage of DP Expansion Diagnosis Function Block, please refer to LK Large Scale PLC Instruction Manual. Users shall note that the Diagnosis library is an external library that shall be first installed in the Library Manager before use.

The diagnosis information of DP slave station modules can be classified to 3 categories: device diagnosis, identifier diagnosis and channel diagnosis. All diagnosis data exist in the form of block structure.

- **Device Diagnosis:** records of the overall diagnosis information of the module, such as, power loss of field power supply.
- **Module Diagnosis:** records of whether the module has diagnosis information.
- **Channel Diagnosis:** records of the channel level diagnosis information, such as disconnection and rang exceeding.

Output channels of LK511 provide channel diagnoses such as line-break diagnosis and channel output failure diagnosis. After the DP slave station expansion diagnosis function block (HS_DPSlaveAlarm) is called, the channel diagnosis data reported by LK511 will be stored in the corresponding fields of the output parameter "AlarmInfo", as shown in Table 6.6. Channel retains old diagnosis data if no new data reported.

Diagnosis Information		Value	Definition
Channel Diagnosis	ChDiag.Module.Channel.ChNo	1~4	Channel Number of the Failure
	ChDiag.Module.Channel.Error	6	Line-Break
		18	Channel Output Failure
		0	Failure Recovered

Table 6.6: Definition of LK511 Diagnosis Information

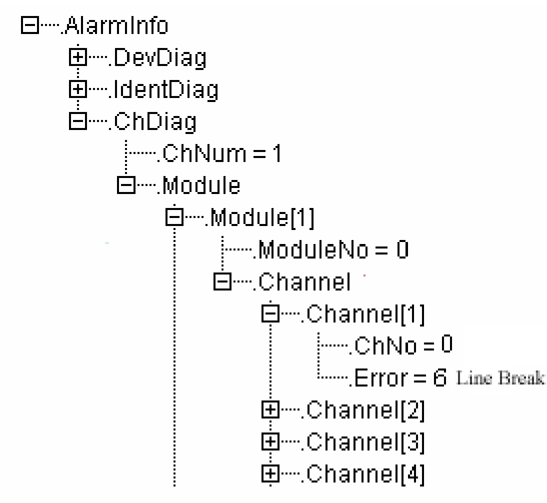


Figure 6.20: Definition of LK511 Diagnosis Information

Channel Read-Back and Failure Diagnosis

LK511 module has channel read-back diagnosis circuit built in its hardware.

The channel output data can be reported to the controller in the form of read-back, so that users can acquire and check output signals at any time. This improves the reliability of AO control. Meanwhile, LK511 module can automatically check channel output status through read-back data to complete the failure diagnosis function.

0~4mA of each channel is the Read-Back Deadband. Therefore, for the 0~21mA range, the valid range of read-back diagnosis is 4~21mA; while for 0~4mA range, the read-back function will automatically be invalid. And for 4~20mA range, the read-back diagnosis are valid for the full range.

LK511 completes the line-break and output failure diagnoses on its output channels through the read-back value. CPU compares the actual read-back value with the theoretic value to diagnose the channel status and report the diagnosis data. The principles are as follows:

- Read-back current <4m A, then the output circuit is open and channel line-break, channel diagnosis byte reports "Line-Break".
- Difference between actual read-back value and theoretic value >5% of the full range, then channel diagnosis byte reports "Channel Output Failure";
- When all failures recovered in the channel, channel diagnosis byte reports "Failure Recovered".
- If no load is added to the channel, it will be considered as a link-break, channel reports "Line-Break".

LK511 module will only report the diagnosis data once respectively when failure occurs and is recovered. For different output ranges selected by users, the module takes different processes of failures. Refer to Table 6.7 for details. When all failures recovered in the channel and it outputs normally again, channel diagnosis byte reports 0x00.

Output Range	Diagnosis Valid Range	Failure Types	Processes, Read-Back Data and Diagnosis Bytes
4~20mA	4~20mA	Line-Break	1. Channel read-back data report 0x00 2. Channel diagnosis byte reports line-break value 0x06
		Output Failure	1. Difference between actual read-back value and theoretic value >5% of the full range. 2. Channel diagnosis byte reports output failure value 0x12
0~21mA	4~21mA	Line-Break	1. Channel read-back data report code value≈0x22 (e.g. not zero) 2. Channel diagnosis byte reports line-break value 0x06
		Output Failure	1. Difference between actual read-back value and theoretic value >5% of the full range. 2. Channel diagnosis byte reports output failure value 0x12

Table 6.7: LK511 Processes of Channel Failures in Different Ranges

The line-break diagnosis and output failure diagnosis can be configured in the software while by default they are disabled. If a input channel is not wired, it will be considered as disconnected. Therefore, for the channels not in use, it is suggested to disable the line-break diagnosis function, e.g. to keep the default value of parameter "Diagnosis".

6.2.7 Parameter Specifications

The controller can only read and write the high-speed I/O information regularly after it entered data exchange mode. Therefore, in order to provide correct parameter information in the initialization process, users shall first set the parameters in the configuration software.

The configuration of LK511 hardware functions involves settings of "DP Parameter", "User Parameter" and "Input/Output". Without special specifications, other parameters shall keep their default value.

Communication Parameters

Supporting PROFIBUS-DP slave station protocol, LK511 completes data exchanges and diagnosis information reporting with the controller and other DP master stations. The slave station adopts a unique communication address, which is determined by the backplane number and the slot number of the LK511 module. *Refer to Chapter 2: Backplanes for the allocation of communication address.*

As shown in Figure 6.21, the communication address of LK511 module shall be filled into the field "Station Address".

If modules have been added or deleted in the configuration software, or the slot number of module on the backplane has been changed, the communication address in "DP Parameter" shall be check to ensure the accuracy.

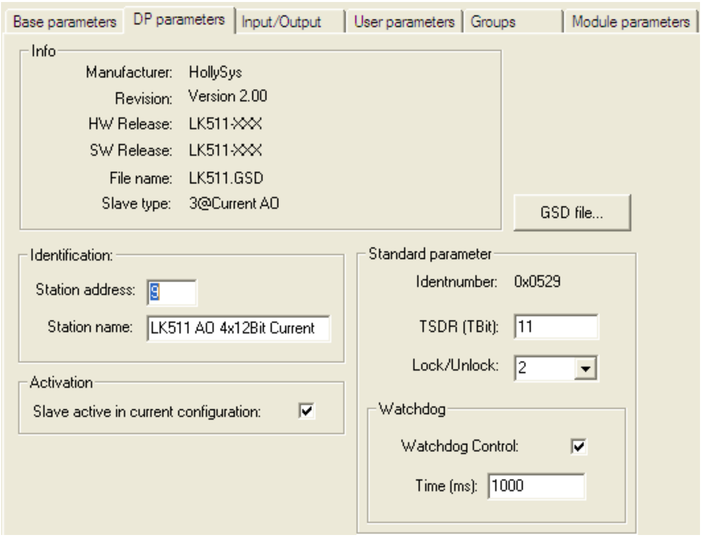


Figure 6.21: Setting of LK511 Communication Parameters

User Parameters

User parameters are used to configure the module's operating mode. They are written into the controller during the download of user program and will not be read in every scanning circle. Each parameter has a default value that can be changed according to requirements of the project. User parameters do not support online modification; therefore they can only be effective after the full download.

The "User Parameter" of LK511 module totally occupies 22 bytes for the setting of channel ranges, programming mode value and fault mode value.

Parameter Name	Parameter Definition	Parameter Value
CH1 Output Range	Range Selection of Channel 1	68: 4~20mA (Default) 69: 0~21mA
CH2 Output Range	Range Selection of Channel 2	
CH3 Output Range	Range Selection of Channel 3	
CH4 Output Range	Range Selection of Channel 4	
CH1 Program Mode Output	Program Mode Output of Channel 1	0: Hold Last Value, retains output (default) 1: Program Mode value, outputs programming mode value
CH2 Program Mode Output	Program Mode Output of Channel 2	
CH3 Program Mode Output	Program Mode Output of Channel 3	
CH4 Program Mode Output	Program Mode Output of Channel 4	
CH1 Program Mode Value	Program Mode Value of Channel 1	0 (Default) ~65535 *Refer to section "Data Format" for the calculation.*
CH2 Program Mode Value	Program Mode Value of Channel 2	
CH3 Program Mode Value	Program Mode Value of Channel 3	
CH4 Program Mode Value	Program Mode Value of Channel 4	
CH1 Fault Mode Output	Fault Mode Output of Channel 1	0: Hold Last Value, retains output (default) 1: Fault Mode Output, outputs fault mode value
CH2 Fault Mode Output	Fault Mode Output of Channel 2	
CH3 Fault Mode Output	Fault Mode Output of Channel 3	
CH4 Fault Mode Output	Fault Mode Output of Channel 4	
CH1 Fault Mode Value	Fault Mode Value of Channel 1	0 (Default) ~65535 *Refer to section "Data Format" for the calculation.*
CH2 Fault Mode Value	Fault Mode Value of Channel 2	
CH3 Fault Mode Value	Fault Mode Value of Channel 3	
CH4 Fault Mode Value	Fault Mode Value of Channel 4	
CH1 Diagnosis	Channel 1 Diagnosis enabled (Channel line break diagnostic and output faulty diagnostic.)	0: Disable, the function is disabled (default); 1: Enable, the function is enabled.
CH2 Diagnosis	Channel 2 Diagnosis enabled	
CH3 Diagnosis	Channel 3 Diagnosis enabled	
CH4 Diagnosis	Channel 4 Diagnosis enabled	

Table 6.8: List of LK511 User Parameters

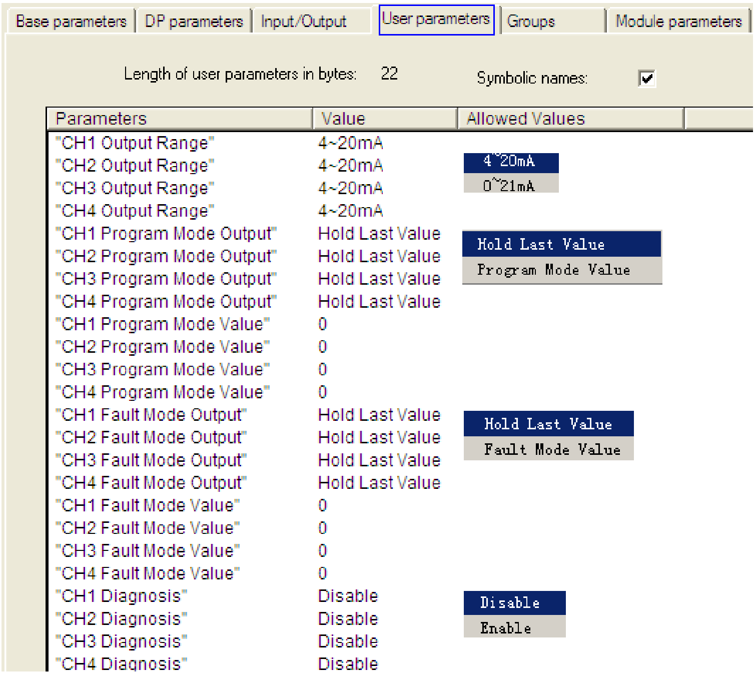


Figure 6.22: Setting of LK511 User Parameters

Specifications of Data Area

In "Input/Output", the input module (Read Back) and output module (4 Channels AO) on the left column are selected into the right column, indicating that LK511 needs to transmit data of these two parts, as shown in Figure 6.23. Data of these two modules are separately from each other. If the input module is not added, then the channel read-back data of LK511 will not be reported to the controller.

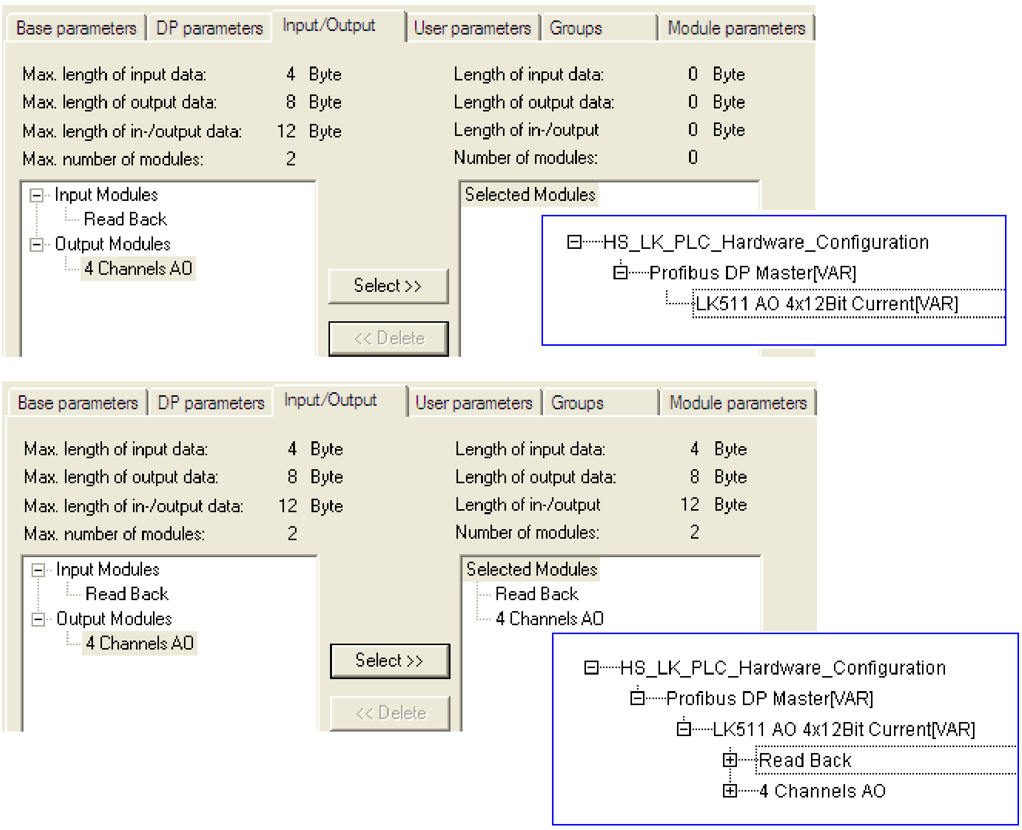


Figure 6.23: Adding Modules in LK511 Input/Output Parameter

Data of LK511are divided into input data and output data. Output data are the current signals sent by the controller to LK511 output channels, which occupy 4 WORD variable with each WORD variable (0~65535) correspondence to one channel output data. Input data is the channel read-back data sent by LK511 to the controller, which occupy 4 BYTE variables with each BYTE variable (0~255) correspondence to one channel read-back data.

Area Definition	Data Length	Data Definition	Value Range	Correspondence Current Value
Output Data	1WORD	Output data of CH1	0x0000~0xFFFF	0x0000 correspondence to 4mA or 0mA 0xFFFF correspondence to 20mA or 21mA
	1WORD	Output data of CH2	0x0000~0xFFFF	
	1WORD	Output data of CH3	0x0000~0xFFFF	
	1WORD	Output data of CH4	0x0000~0xFFFF	
Input Data	1BYTE	Read-back data of CH1	0x00~0xFF	0x00 correspondence to 4mA or 0mA 0xFF correspondence to 20mA or 21mA
	1BYTE	Read-back data of CH2	0x00~0xFF	
	1BYTE	Read-back data of CH3	0x00~0xFF	
	1BYTE	Read-back data of CH4	0x00~0xFF	

Table 6.9: List of LK511 Input/Output Data

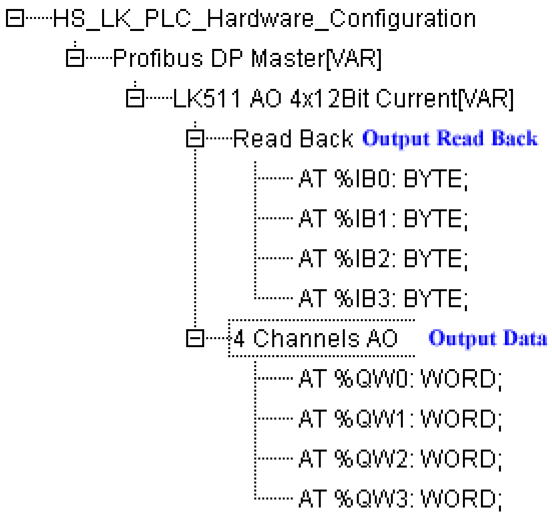


Figure 6.24: LK511 Input/Output Data

6.2.8 Module Installation and Un-installation

Refer to chapter 1 on "Module Insertion Mechanical keys" and "Module Insertion and Removable" for more details.

6.2.9 Technical Specification

LK511 4-Channel Inter-Channel Isolation Current AO Module				
System Power Supply				
Power Supply Voltage			24VDC(-15%~+20%)	
Power Consumption			180mA max.@24VDC (in condition of 20mA, 4 channel all output)	
Output Channel				
Number of Channels			4	
Range Code			68	69
Output Range			4~20mA	0~21mA
Output Data Format			0x0000~0xFFFF	0x0000~0xFFFF
Read-back Data Format			0x00~0xFF	0x00~0xFF
Output Establishment Time			<2ms	
Load Capacity			750Ω max.	
DAC Resolution			12 digits	
Read-back ADC Resolution			8 digits	
Channel Output Temperature Drift			50ppm/ºC	
Isolation voltage between the channel and system			500VAC@1min, Current Leak 5mA	
Isolation voltage between channels			500VAC@1min, Current Leak 5mA	
Reset Output	Power-on Reset (Cold Reset)		0mA	
	Hot Reset		Output retains	
Precision	Output	0~4mA Range	0.6%F.S.	
		4~21mA Range	0.3%F.S.	
	Read-back		5%F.S in 4~21mA range; 0~4mA is the read-back deadband, read-back data is nearly 4mA within this range	
Stability	Output		0.05%F.S.	
	Read-back		2.5%F.S.	
Failure Diagnosis and Hot swap				
Line-Break Detection			Channel Line-Break (Enabled in Configuration), channel diagnosis byte reports 0x60. Connection recovered, channel reports 0x00	
Output Failure Detection			Channel output failure (Enabled in Configuration), channel diagnosis byte reports 0x12. Failure recovered, channel reports 0x00	
Hot swap			Support	
Communication Bus				
protocol			PROFIBUS-DP Slave Station, in accordance with IEC61158-3/EN50170 standards	
Baud Rate			Baud Rate Options: 1.5Mbps, 500Kbps, 187.5Kbps, 93.75Kbps, 45.45Kbps, 31.25Kbps, 19.2Kbps, 9.6Kbps	
Media			Communication bus is connected to the backplane through euro connector, hot redundant communication media	
Physical Features				
Mechanic Keys to Prevent Incorrect Insertion			C1	
Installation Location			LK local backplane or expansion backplane	
Dimension			Width × Height × Depth = 35mm×100mm×100mm	
Casing Protection Level			IEC60529 IP20	
Weight			180g	
Working Environment				
Working Temperature			0ºC~60ºC	
Working Relative Humidity			5%~95%, no condensate	
Storage Temperature			-40ºC~70ºC	
Storage relative Humidity			5%~95%, no condensate	

Table 6.10: Technical Specification of LK511 Module

Chapter

7

CHAPTER 7: ANALOG INPUT/OUTPUT MODULE

7.1 LK810 [4-CHANNEL AI AND 2-CHANNEL AO MODULE]

7.1.1 Features

- 4 channels of voltage or current inputs, 2 channels of voltage or current outputs
- Input Signal: -10.25~+10.25V / 0~10.25V / 0~5.125V / 4~20.58mA / 0~20.58mA
- Output Signal: -10.25~+10.25V / 0~10.25V / 0~5.125V / 4~20mA / 0~21mA
- Input Channel Limit Exceeded Alarm
- Input Channel Range Exceeded Alarm
- Program mode output
- Support ProfiBus-DP slave station protocol
- System-to-Field Isolation
- Input Channel Line-Break Detection
- Output Channel Overload Detection
- Fault Mode Output
- Supports hot swap

7.1.2 Operation Principles

Input Channel: voltage signals from the field go through filter, voltage division and A/D conversion and be read by LK810 micro-processor as the acquired code value; while current signals go through I/V conversion, filter, voltage division and A/D conversion and be read by LK810 micro-processor as the acquired code value. All code values are reported to the controller through PROFIBUS-DP bus.

Output Channel: the controller sends output signals to LK810 through PROFIBUS-DP bus to control DAC to output proper voltage signals, then the driver circuit receive the voltage signals output by DAC and output correspondence voltage/current signals to control field load.

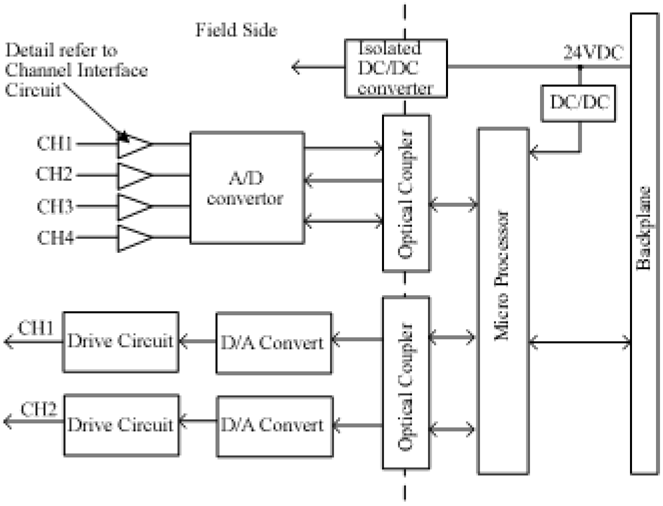


Figure 7.1: Internal Structure of LK810 Module

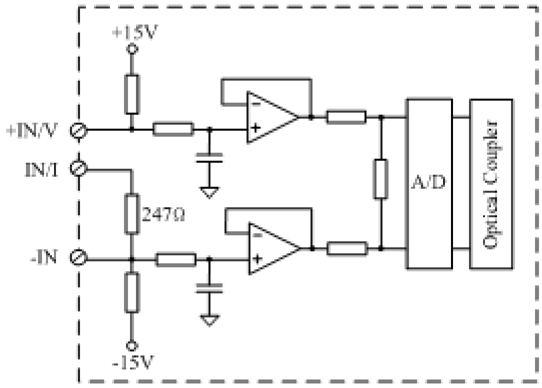


Figure 7.2: LK 810 Input Channel Interface Circuit

7.1.3 Indicators Definition

Refer to section 5.1.1: The LED Status indicator

7.1.4 Wiring Specifications

When all its input channels are connected to two-wire transformers, LK810 module does not supply power to external devices. Therefore, a separated 24V DC field power supply shall be adopted by each input channel to provide power to the transformer. To ensure the isolation between field and system, the field power supply shall be separated from the backplane power supply.

LK810 module is installed on LK series backplanes that support two types of wirings: terminal wiring and prefabricated cable wring.

Wiring to Backplane Terminals

LK810 module is connected to field signals through the correspondence terminals under the backplane installation slot. The relationship between each channel and terminal is shown in Table 7.1.

Channel Number	Terminal Number			
	Voltage Signal		Current Signal	
Input Channel	Positive End (+IN/V)	Negative End (-IN)	Positive End (+IN/I)	Negative End (-IN)
Channel 1	01	05	03/01**	05
Channel 2	02	06	04/02	06
Channel 3	07	11	09/07	11
Channel 4	08	12	10/08	12
Output Channel	Positive End (VIout)	Negative End (Com)	Positive End (VIout)	Negative End (Com)
Channel 1	13	15	13	15
Channel 2	14	16	14	16

Table 7.1: Definitions of LK810 Backplane Wiring Terminals

*** Short connected Terminal 01 and 03, similar application to other channels.*

In the wiring, the following shall be noted:

- Each channel of AI or AO signals of the field is connected to its respective terminal through two (shielded) cables.
- The input channels do not supply power to the transformer; therefore a separated field 24V DC power supply will be needed when the channel is connected to a two-wire transformer.
- For current signals, Terminal 03 and Terminal 01 of Channel 1 can be short connected to be the positive end of current input, Terminal 04 and Terminal 02 of Channel 2 can be short connected to be the positive end of current input, similar applications to other channels.
- Terminal 17 and Terminal 18 shall not be used in wiring.
- A single terminal shall not be connected to many wires, therefore multiple-point connection can be established through bus bar or transferring terminal board.

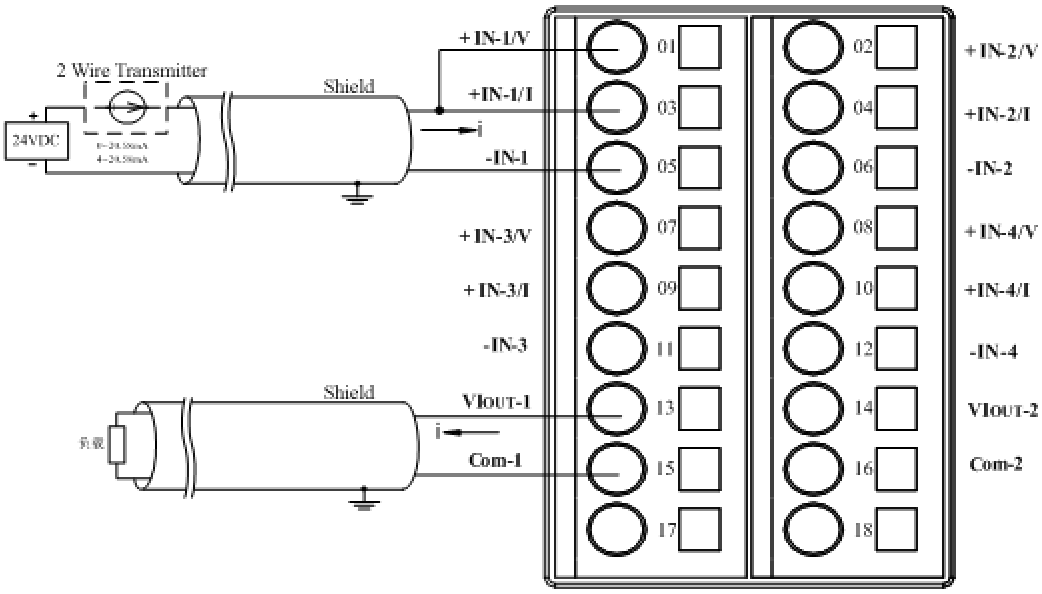


Figure 7.3: Backplane Terminal Wiring of 4-wire Current Signals

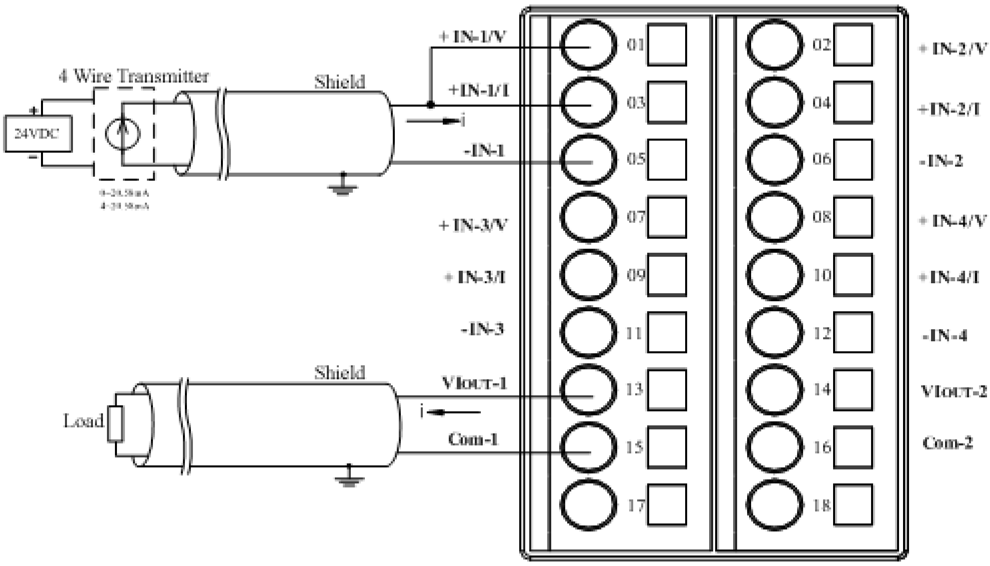


Figure 7.4: Backplane Terminal Wiring of 2-wire Current Signals

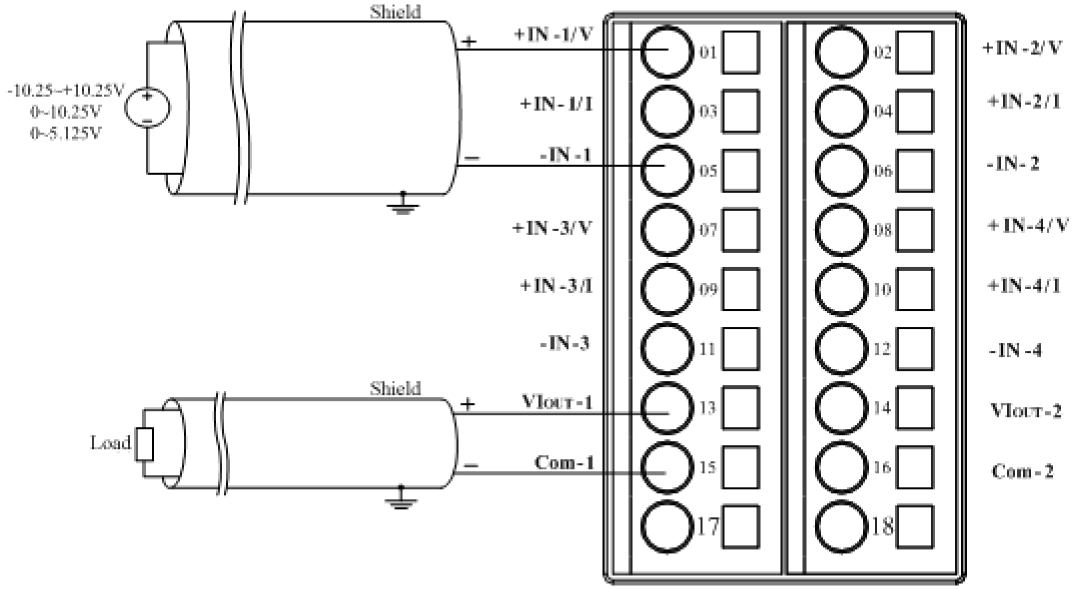


Figure 7.5: Backplane Terminal Wiring of Voltage Signals

Wiring to Terminal Modules

Please refer to the information found on Chapter 12: Terminal Module.

7.1.5 Function Specifications

Data Output Format

As shown in Table 7.2, the measurement data of LK810 AI channels and the output data sent by the controller to its AO channels are represented by 2byte positive integer codes (decimal value range 0~65535). Among which, the voltage range (-10.25~+10.25V) are divided into two segments, the positive voltage (0~10.25V) signals are represented by decimal code value range 0~32767 while the negative voltage (-10.25~1LSB) signals by decimal code value range 32768~65535.

-1LSB represent (-10.25~10.25V) minimum resolution of voltage measurement range, value code 65535 corresponding to -0.0003128V voltage signal.

Channel Type	Signal Type	Maximum Range		Decimal Code Value
AI	Voltage	-10.25~+10.25V	0~10.25V	0~32767
			-10.25V~1LSB	32768~65535
		0~10.25V		0~65535
		0~5.125V		0~65535
	Current	4~20.58mA		0~65535
		0~20.58mA		0~65535
AO	Voltage	-10.25~+10.25V	0~10.25V	0~32767
			-10.25V~1LSB	32768~65535
		0~10.25V		0~65535
		0~5.125V		0~65535
	Current	4~20mA		0~65535
		0~21mA		0~65535

Table 7.2: The Corresponding Relation of LK810 Channel Signal and the Decimal Code

The channel data of the Voltage Range (-10.25~+10.25V) can be converted to their corresponding codes by the following equation:

- Positive voltage 0~+10.25V: Voltage Value (V) = channel data/32767×10.25
- Negative Voltage -10.25~1LSB: Voltage Value (V) = (channel data -65535)/32767×10.25

The function block HS_HEX_ENGIN in the analog conversion library HS_AnalogConvert.lib of the configuration software PowerPro V4 can be called to convert the 2bytes measurement data of the input

channel into engineering data; while the function block HS_ENGIN_HEX can convert the engineering data into the 2bytes code values that will be sent to the output channels.

(Field Side signal that being measured include pressure, temperature and voltage etc. After user define the upper and lower limit of engineer units, function block will output the corresponding value according to the measurement value automatically.)

For detailed usage of the function block, please refer to LK Series PLC - Instruction Manual.

To configure the alarm upper and low limits, fault mode value and program mode value in user parameters, the electrical signals (voltage or current) shall be filled in after converted into decimal machine codes. For different ranges, the machine code conversion methods are different.

For the ranges of 0~10.25V, 0~5.125V, 0~20.48mA and 0~21mA, the Signal conversion equation is as follow:

Machine Code Value = Signal×65535/Full Range Value*

**Full-Range value equal to maximum measurable value minus minimum measurable value*

Take AO channel 1 for example, if its range is set to "0~10.25V" and the user-defined program mode output is 5V, then the Program Mode Value=5×65535/10.25=31968. The user parameter configuration is as shown in Figure 7.6.

"AO CH1 Range"	0~10.25V
"AO CH2 Range"	-10.25~+10.25V
"AO CH1 Program Mode Output"	Program Mode Value
"AO CH2 Program Mode Output"	Hold Last Value
"AO CH1 Program Mode Value"	31968
"AO CH2 Program Mode Value"	0

Figure 7.6: Example of Program Mode Parameter Setting in Set Range

For AI channel 4~20.58mA range and AO channel 4~20mA range, the Signal conversion equation is as follow:

- Code Value = (Current Signal - 4) × 65535/Full Range Current

Where for 4~20.58mA range, Full Range Current =16.58mA, for 4~20mA, Full Range Current =16mA. Take AO channel 2 for example, if its range is set to "4~20mA" and the user-defined fault mode output is 18mA, then the Fault Mode Value=(18-4)×65535/16=57343. The user parameter configuration is as shown in Figure 7.7.

"AO CH1 Range"	-10.25~+10.25V
"AO CH2 Range"	4~20mA
"AO CH1 Fault Mode Output"	Hold Last Value
"AO CH2 Fault Mode Output"	Fault Mode Value
"AO CH1 Fault Mode Value"	0
"AO CH2 Fault Mode Value"	57343

Figure 7.7: Example of Fault Mode Parameter Setting in Set Range

For the ranges of -10.25~+10.25V, the Signal conversion equation is as follow:

- Positive Voltage Range (0~10.25V): Machine Code Value = Positive Voltage Signal ×32767/10.25
- Negative Voltage Range (-10.25~1LSB): Machine Code Value = 65535 + (Negative Voltage Signal ×32767/10.25)

Take AI channel 1 for example, if its voltage range is set as "-10.25+10.25V" with limit exceed alarm enabled and the user defined alarm upper limit is 9V while the lower limit is -9V, then Alarm Upper Limit = 9×32767/10.25=28771; Alarm Lower Limit =65535+ (-9×32767/10.25)=36764. The user parameter configuration is shown as Figure 7.8.

"AI CH1 Range"	-10.25~+10.25V
"AI CH2 Range"	-10.25~+10.25V
"AI CH3 Range"	-10.25~+10.25V
"AI CH4 Range"	-10.25~+10.25V
"AI CH1 UpperLimit Exceeded Alarm"	Enable
"AI CH1 LowerLimit Exceeded Alarm"	Enable
"AI CH2 UpperLimit Exceeded Alarm"	Disable
"AI CH2 LowerLimit Exceeded Alarm"	Disable
"AI CH3 UpperLimit Exceeded Alarm"	Disable
"AI CH3 LowerLimit Exceeded Alarm"	Disable
"AI CH4 UpperLimit Exceeded Alarm"	Disable
"AI CH4 LowerLimit Exceeded Alarm"	Disable
"AI CH1 UpperLimit Value"	28771
"AI CH1 LowerLimit Value"	36764

Figure 7.8: Limit Exceeded Alarm Parameter Setting Example in Negative Range

Program Mode

Program mode is a working mode of the controller to modify, edit and download user programs. In program mode, user programs are halted and cannot be restarted through programming software. Not under control, the output channel of LK810 module retains output or outputs a value preset in the configuration, known as the Program Mode Value.

Under program mode, whether the module retains output or outputs program mode value can be configured in software. Modifications will only be effective after the full download Special notes shall be taken that: after the full down and before the operation, the module is under program mode and outputs previous program mode value. The new value will only replace the previous one after the operation of user program.

Controller can make the slave station into or out of program mode through the following methods:

- Turn the key switch to "PRG" to force all output modules into program mode. Then, operation of user program halts, LK810 output channels output program mode value.
- After the full-download of user program, output module automatically enters program mode no matter whether the controller key switch is located at "PRG". If the module has never output any data before the download (e.g. output is not enabled), it will retain the initial status and does not output. If the module output has been enabled before the download, output channel of the module outputs program mode value.
- Turn the key switch to "RUN", slave station gets out of program mode and controller runs the user program, the output is enabled.

Please note the if the module has never been output enabled, it does not output program mode value even it enters program mode.

Program mode value is configured by user parameter "Program Mode value", default value of which is "Hold Last Value". Program mode value is configured by user parameter "Program Mode value", default output of which is 0. (Range 4~20mA, Code Value:0 Corresponding output 4mA; Range 0~21mA, Code Value:0 Corresponding output: 0mA)

Refer to section on "Data Output Format" for the calculation method of the program mode value. Parameters of each channel are configured separately without interfere to others.

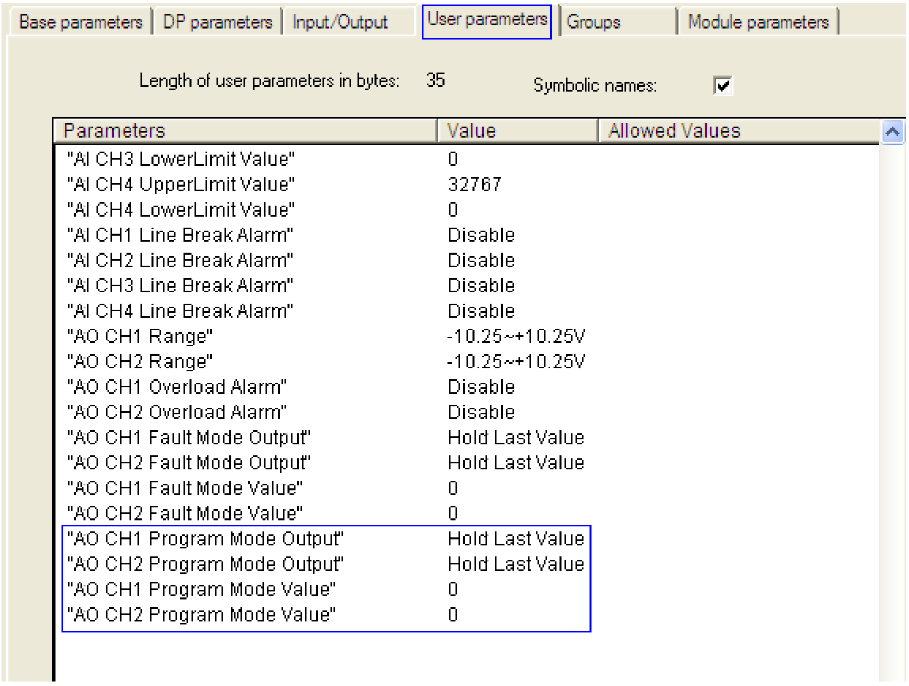


Figure 7.9: LK810 Output Setting under Program Mode

7.1.6 Communication Failure

- When communication failure occurs, the communication between controller and output module breaks and the "RUN" light flashes. The module may be in one of the following states in communication failure:
- After power on, module cannot establish communication with the controller, then the module will retain the initial status and its output is not enabled.
- Module in operation when communication failure occurs: module retains output or outputs a value preset in the configuration, known as the Fault Mode Value. Whether the module retain output or outputs fault mode value can be configured in software. After the communication re-established, the module receives and executes the output instructions from the controller again with the "RUN" light constantly on.
- Module in program mode when communication failure occurs: module enters fault mode and outputs fault mode value. When failure recovered, module returns to program mode automatically and outputs program mode value again with the "RUN" light constantly on.
- If the module output has not been enabled, the module does not output fault mode value even if any communication failure occurs.
- Fault mode Output of output channel is configured by user parameter "Fault Mode Output", default value of which is "Hold Last Value". Fault mode value is configured by user parameter "Fault Mode value", default output of which is 0. *Refer to section "Data Output Format" for the calculation method of the fault mode value.*
- Parameters of each channel are configured separately without interfere to others.

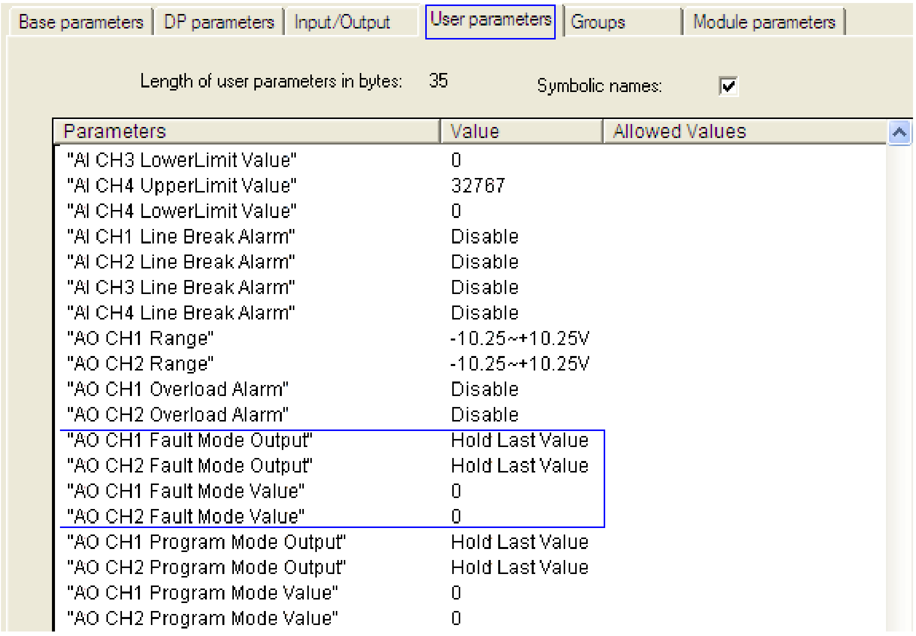


Figure 7.10: LK810 Fault Mode Value Setting

7.1.7 Diagnosis Specifications

PowerPro V4 configuration software adopts external diagnosis library to check and acquire all kinds of diagnosis information, such as whether the module and its channels are operating normally and whether the module parameters are set correctly.

For the DP slave station modules, the DP slave station expansion diagnosis function block (HS_DPSlaveALarm) shall be called to check the DP module at any address on the PROFIBUS-DP link, as shown in Figure 7.11.

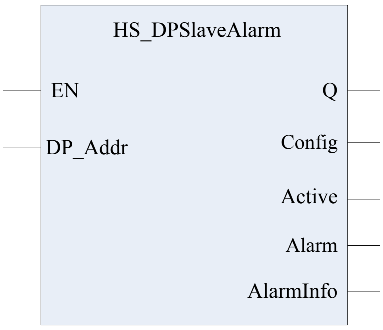


Figure 7.11: Expansion Diagnosis Function Block for DP Slave Station

For detailed usage of DP Expansion Diagnosis Function Block, please refer to LK Large Scale PLC Instruction Manual. Users shall note that the Diagnosis library is an external library that shall be first installed in the Library Manager before use.

The diagnosis information of DP slave station modules can be classified to 3 categories: device diagnosis, identifier diagnosis and channel diagnosis. All diagnosis data exist in the form of block structure.

- Device Diagnosis: records of the overall diagnosis information of the module, such as, power loss of field power supply.
- Identifier Diagnosis: records of whether the module has diagnosis information.
- Channel Diagnosis: records of the channel level diagnosis information, such as disconnection and rang exceeding.

Range exceeding, limit exceeding and line-break diagnoses can be applied to the input channels of LK810 while the overload diagnosis can be applied to the output channels. All these diagnoses are channel diagnoses. After the DP slave station expansion diagnosis function block (HS_DPSlaveAlarm) is called, the channel diagnosis data reported by LK810 will be stored in the corresponding fields of the output parameter “AlarmInfo”, as shown in Table 7.3.

Diagnosis Information		Value	Definition
Input Channel Diagnosis	ChDiag.Module.Module[1].Channel.ChNo	1~4	Channel Number of the Failure
	ChDiag.Module.Module[1].Channel.Error	2	Short of Range
		3	Over Range
		6	Line-Break
		7	Upper Limit Exceeded
		8	Lower Limit Exceeded
		0	Channel Failure Recovered
Output Channel Diagnosis	ChDiag.Module.Module[2].Channel.ChNo	1~2	Channel Number of the Failure
	ChDiag.Module.Module[2].Channel.Error	4	Overload

Table 7.3: Definition of LK810 Diagnosis Information

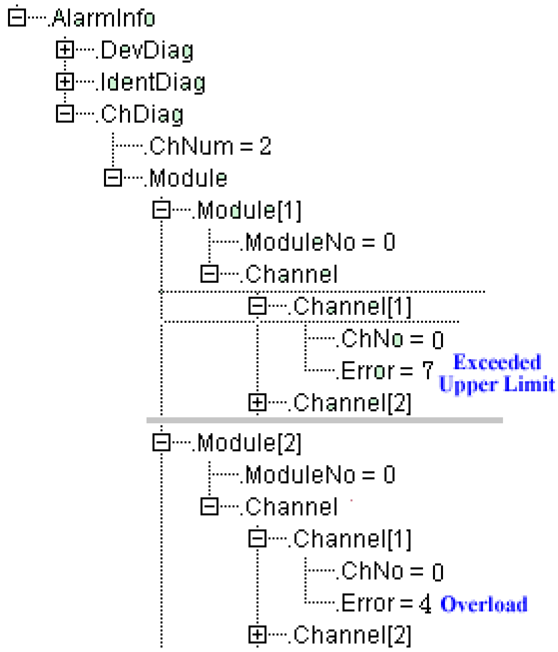


Figure 7.12: Definition of LK810 Diagnosis Information

AI Channel Range Exceeded Alarm

LK810 input channels provide range exceeded alarm function. When the input signals exceed the preset measurement range, Channel Diagnosis will report "Over Range", when the signal fell back into range again, it will report "Failure Recovered".

LK810 module will only report the diagnosis data once respectively when signals exceeded range and when the failure is recovered.

Maximum Measurement Range	Measurement Range	Measurement Range Exceeding	
		Over Range	Short of Range
0~20.58mA	0~20mA	>20mA	<0mA
4~20.58mA	4~20mA	>20mA	<4mA
-10.25V~10.25V	-10V~10V	>10V	<-10V
0~10.25V	0~10V	>10V	<0V
0~5.125V	0~5V	>5V	<0V

Table 7.4: Range Definition of LK810 Rang Exceeded Alarm

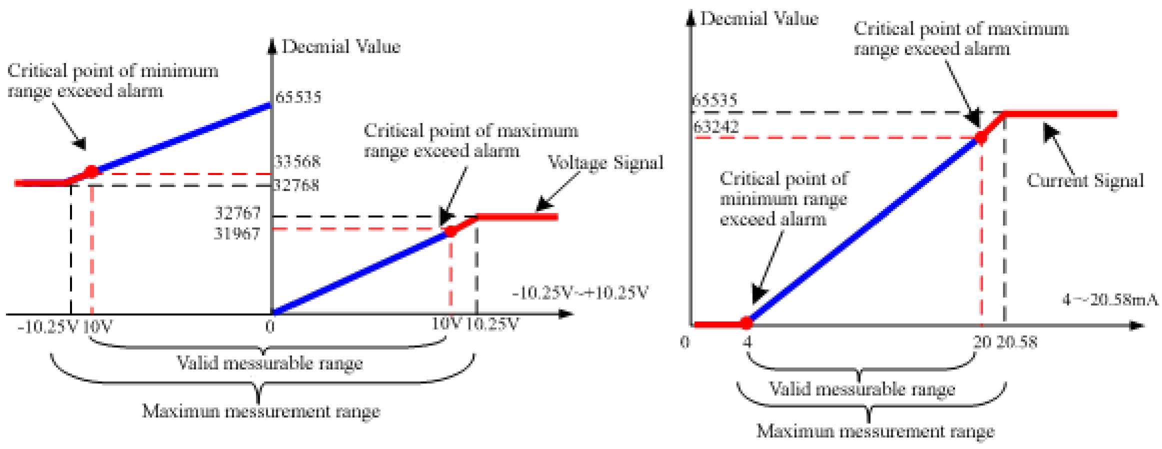


Figure 7.13: Range Exceeded Alarm Diagnosis of LK810

As for different ranges set by users, the module provides different diagnosis processes of rang exceeding, as shown in Table 7.5. When signals fall back into the normal range, the channel will report diagnosis byte 0x00.

Maximum Measurement Range	Valid Range	Range Exceeding	Process of Range Exceeding
0~20.58mA	0~20mA	Over Range	The channel will report diagnosis byte of over-range failure value 0x03 20~20.58mA, channel reports the code values 63688~65535 of the measured data >20.58mA, channel reports 65535
		Short of Range	The channel will report diagnosis byte of short of range value 0x02 CChannel reports 0 as measurement data
4~20.58mA	4~20mA	Over Range	The channel will report diagnosis byte of over-range failure value 0x03 20~20.58mA, channel reports the code values 63242~65535 of the measured data >20.58mA, channel reports 65535
		Short of Range	The channel will report diagnosis byte of short of range value 0x02 CChannel reports 0 as measurement data
-10.25V~10.25V	-10V~10V	Over Range	The channel will report diagnosis byte of over-range failure value 0x03 10~10.25V, Channel reports the code value 31967~32767 of the measured data >10.25V, channel reports 32767
		Short of Range	The channel will report diagnosis byte of short of range value 0x02 -10.25~-10V, Channel reports the code value 32767~33568 of the measured data <-10.25V, channel reports 32768
0~10.25V	0~10V	Over Range	The channel will report diagnosis byte of over-range failure value 0x03 10~10.25V, channel reports the code values 63937~65535 of the measured data >10.25V, channel reports 65535
		Short of Range	The channel will report diagnosis byte of short of range value 0x02 CChannel reports 0 as measurement data
0~5.125V	0~5V	Over Range	The channel will report diagnosis byte of over-range failure value 0x03 5~5.125V, channel reports the code values 63937~65535 of the measured data >5.125V, channel reports 65535
		Short of Range	The channel will report diagnosis byte of short of range value 0x02 CChannel reports 0 as measurement data

Table 7.5: LK810 Processes of Rang Exceeded Alarm for Different Range

AI Channel Limit Exceeded Alarm

LK810 input channels provide limit exceeded alarm function. Users can configure the upper and lower alarm limits of input signals within the set measurement range. When input signals exceed the alarm value (higher than the alarm upper limit or lower than the alarm lower limit), channel diagnosis byte reports limit exceeded failure.

LK810 module will only report the diagnosis data once respectively when signal exceeds limits and when the failure is recovered. The limit exceeded alarm can be enabled through configuration software, the default setting of which is “disabled”.

In case the input signals of one channel exceed limit:

- When signals exceed the upper limit, the channel diagnosis byte reports 0x07
- When signals exceed the lower limit, the channel diagnosis byte reports 0x08
- The channel reports the code value of the currently measured signal.
- When signals fall back into the normal range, the channel diagnosis byte reports 0x00.

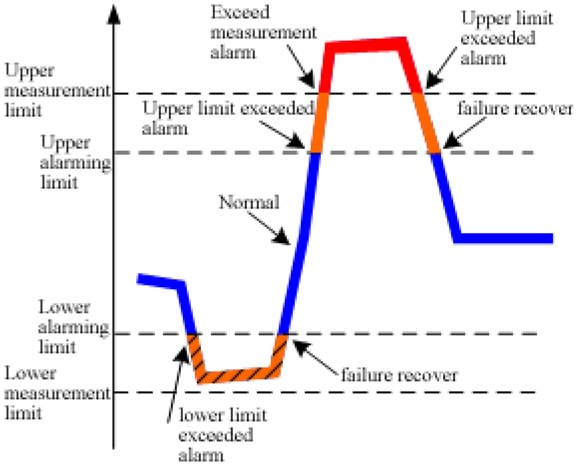


Figure 7.14: Limit Exceeded Alarm Diagnosis of LK810

As shown in Table 7.6, the alarm upper limit voltage (or current) must be higher than the lower limit voltage (or current), otherwise, LK810 shall not be able to report the diagnosis information correctly.

Measurement Range	Alarm Signal
0~20.58mA	0mA<Upper Limit Current<Lower Limit Current<20mA
4~20.58mA	4mA<Upper Limit Current<Lower Limit Current<20mA
-10.25V~10.25V	-10V<Lower Limit Voltage<Upper Limit Voltage<10V
0~10.25V	0V<Lower Limit Voltage<Upper Limit Voltage<10V
0~5.125V	0V<Lower Limit Voltage<Upper Limit Voltage<5V

Table 7.6: Value Range of LK810 Alarm Limits

Represented by two bytes of machine codes (decimal 0~65535), the alarm value in the configuration is the machine code value of those measured signal within the set Measurement Range. The value range of the upper alarm limit is 0~65535 and the default value is 32767. The value range of the lower alarm limit is 0~65534 and the default value is 0. Their calculation formulas are as shown in Table 7.7.

Measurement Range		Upper Alarm Limit (Decimal)	Lower Alarm Limit (Decimal)
0~20.58mA		Upper Limit Current×65535/20.58	Lower Limit Current×65535/20.58
4~20.58mA		(Upper Limit Current-4)×65535/16.58	(Lower Limit Current-4)×65535/16.58
±10.25V	-10.25V~1LSB	65535 + (Lower Limit Voltage×32767/10.25)	65535 + (Lower Limit Voltage×32767/10.25)
	0~10.25V	Lower Limit Voltage×32767/10.25	Lower Limit Voltage×32767/10.25
0~10.25V		Upper Limit Voltage×65535/10.25	Lower Limit Voltage×65535/10.25
0~5.125V		Upper Limit Voltage×65535/5.125	Lower Limit Voltage×65535/5.125

Table 7.7: Calculation of LK810 Alarm Value Codes

The lower limit exceeded alarm function is enabled by the configuration of parameter “AI CH1~CH4 Lower Limit Exceeded Alarm” while the upper limit exceeded alarm function is enabled by the configuration of parameter “AI CH1~CH4 Upper Limit Exceeded Alarm”. The default configuration of both is “disabled”. When the alarm functions are enabled, the lower and upper alarm limits can be set through parameters “AI CH1~CH4 Lower Limit value” and “AI CH1~CH4 Upper Limit Value”.

The limit exceeded alarm function, upper and lower alarm limits of the 4 channels are configured separately. If the limit exceeded alarm is enabled, and the limit exceeding and range exceeding occur at the same time, LK810 will report the exceeding of range.

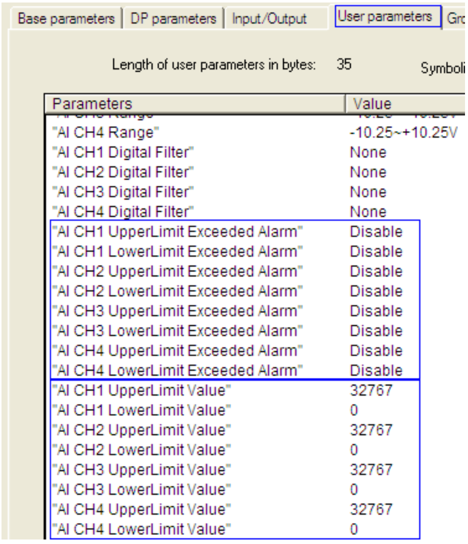


Figure 7.15: Limit Exceeded Alarm Parameters of LK810

AI Channel Line-Break Detection

As shown in Figure 7.16, a pull-up resistor is connected to the signal input end of LK810 module to detect line-break failures in the channels. When line-break occurs in a signal cable of input channel, the channel diagnosis byte reports “Line-Break”, when the failure recovered, the channel diagnosis byte reports “Failure Recovered”.

LK810 module will only report the diagnosis data once respectively when line-break occurs and when the failure is recovered. The line-break alarm can be enabled through configuration software. By default, it is set as disabled. If the AI channel is not wired, it will be considered as disconnected. Therefore, for the channels not in use, it is suggested to disable the Line-Break Alarm function, e.g. to keep the default value of parameter “Line Break Alarm”.

For different types of signals, the module provides different diagnosis processes when line-break occurs, refer to Table 7.8 for details. When signals fall back into the normal range, the channel will report diagnosis byte 0x00.

Signal Type	Line-Break Types	Processes of Line-Break Alarm
Current Signal	Connection-loss of short connected cable (+IN/V)	The channel will report diagnosis byte of over-range failure value 0x03 Channel reports 65535 as measurement data
	Connection-loss of field signal cable (+IN/I, -IN)	Channel reports diagnosis byte of connection-loss value 0x06 Channel reports 0 as measurement data
Voltage Signal	Connection-loss of field signal cable (+IN/V, -IN)	Channel reports diagnosis byte of connection-loss value 0x06 Channel reports 65535 or 32767 (-10.25~10.25V Range) as the measurement data

Table 7.8: LK810 Processes of Line0-Break for Different Signal Types

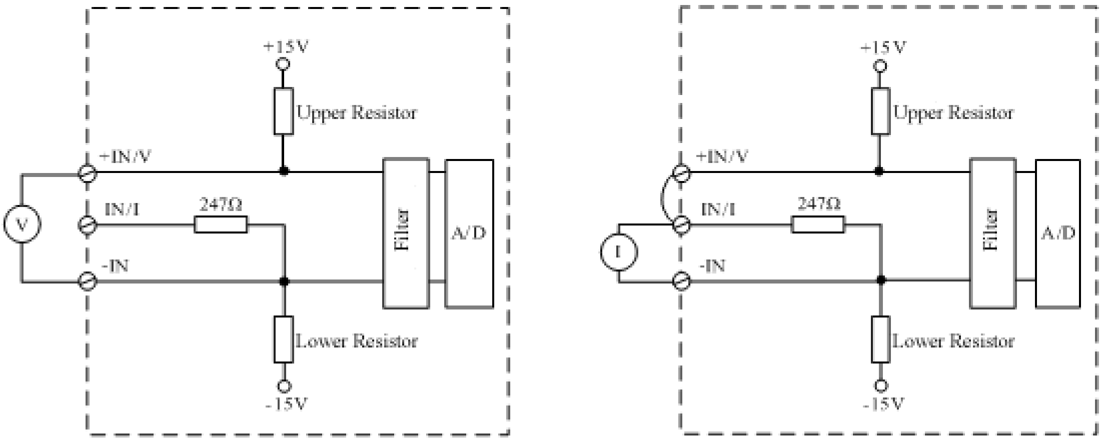


Figure 7.16: LK810 Channel Line-Break Detection Circuit

AO Channel Over-Load Detection

- Output channels of LK810 provide over-load detection function. When over-load occurs in a output channel, channel diagnosis byte reports over-load failure value 0x04. When the load fall back into normal range, channel diagnosis byte reports 0x00.
- The alarm of over-load can be enabled through configuration software, the default setting of which is “disabled”.

Output Voltage Short-Circuit Detection

- For output voltage signals, the drive resistance load >2000Ω.
- In case when field load resistance value is too small and makes the current too large in the output circuit, the current-limit protection output, max<25mA.
- When filed load is short-circuit (load=0), channel will be diagnosed as over-load.

Output Current Short-Circuit Detection

- For output current signals, the drive resistance load range is 0~600Ω.
- When field load resistance value is too large and the voltage on the 2 ends of the load exceeds the output capacity, the channel will be diagnosed as over-load while the output current signal does not meet the precision requirement to drive the field devices normally.
- When filed load is short-circuit (load=∞), channel will be diagnosed as over-load.

7.1.8 Parameter Specifications

The controller can only read and write the I/O information regularly after it entered data exchange mode. Therefore, in order to provide correct parameter information in the initialization process, users shall first set the parameters in the configuration software.

Communication Parameters

Supporting PROFIBUS-DP slave station protocol, LK810 completes data exchanges and diagnosis information reporting with the controller and other DP master stations. The slave station adopts a unique communication address, which is determined by the backplane number and the slot number of the LK810 module. The slave station address shall be correctly filled in the DP parameter field in the configuration software, as shown in Figure 7.17.

Refer to Chapter 2: Backplanes for the calculation of the slave station address.

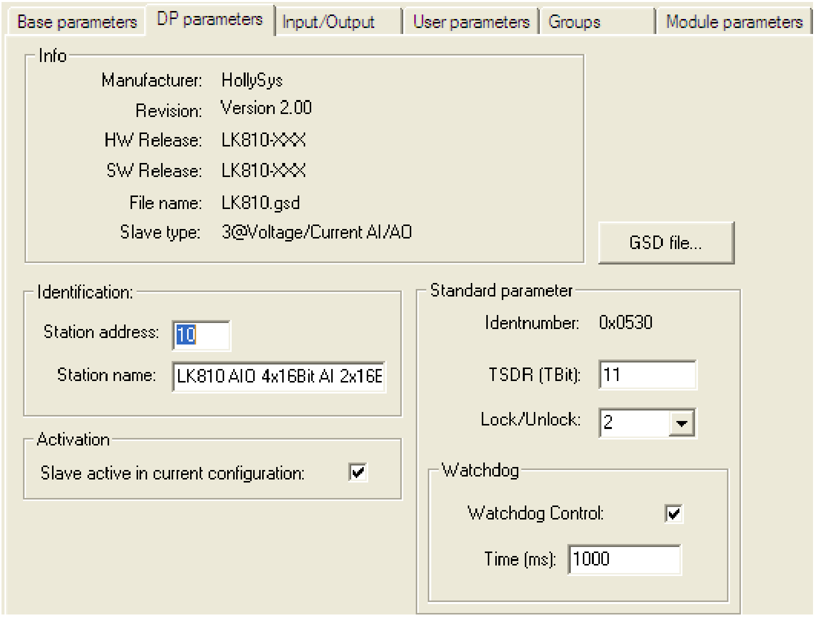


Figure 7.17: Setting of LK810 Communication Parameters

User Parameters

LK810 has total 35 bytes of user parameters.

Parameter Name	Parameter Definition	Value and Definition
Filter Mode	Input Channel Hardware Filter mode	0: no filter, all channel scan period 1460ms 1: 10Hz filter, all channel scan period 95ms 2: 50Hz filter, all channel scan period 410ms (default) 3: 60Hz filter, all channel scan period 500ms 4: 400Hz filter, all channel scan period 1460ms
AI CH1 Range	Range Selection of Input Channel 1	16: -10.25~+10.25V (Default); 17: 0~10.25V 18: 0~5.125V 70: 0~20.58mA 71: 4~20.58mA
AI CH2 Range	Range Selection of Input Channel 2	
AI CH3 Range	Range Selection of Input Channel 3	
AI CH4 Range	Range Selection of Input Channel 4	
AI CH1 Digital Filter	Software Filter Selection of Input Channel 1	0: None, no filter (default) 1: 4Points, select 4 latest history points 2: 8Points, select 8 latest history points 3: 16Points, select 16 latest history points
AI CH2 Digital Filter	Software Filter Selection of Input Channel 2	
AI CH3 Digital Filter	Software Filter Selection of Input Channel 3	
AI CH4 Digital Filter	Software Filter Selection of Input Channel 4	
AI CH1 UpperLimit Exceeded Alarm	Enable the Upper Limit Exceeded Alarm of Input Channel 1	0: Disable, the function is disabled (default); 1: Enable, the function is enabled.
AI CH1 LowerLimit Exceeded Alarm	Enable the Lower Limit Exceeded Alarm of Input Channel 1	
AI CH2 UpperLimit Exceeded Alarm	Enable the Upper Limit Exceeded Alarm of Input Channel 2	
AI CH2 LowerLimit Exceeded Alarm	Enable the Lower Limit Exceeded Alarm of Input Channel 2	
AI CH3 UpperLimit Exceeded Alarm	Enable the Upper Limit Exceeded Alarm of Input Channel 3	
AI CH3 LowerLimit Exceeded Alarm	Enable the Lower Limit Exceeded Alarm of Input Channel 3	
AI CH4 UpperLimit Exceeded Alarm	Enable the Upper Limit Exceeded Alarm of Input Channel 4	
AI CH4 LowerLimit Exceeded Alarm	Enable the Lower Limit Exceeded Alarm of Input Channel 4	
AI CH1 Upper Limit Value	Setting the Alarm Upper Limit Value of Input Channel 1	Value range: 0~65535 Alarm Default Lower Limit: 0 Alarm Default Upper Limit: 32767 Refer to section "*Data Output Format*" for the calculation.
AI CH1 Lower Limit Value	Setting the Alarm Lower Limit Value of Input Channel 1	
AI CH2 Upper Limit Value	Setting the Alarm Upper Limit Value of Input Channel 2	
AI CH2 Lower Limit Value	Setting the Alarm Lower Limit Value of Input Channel 2	
AI CH3 Upper Limit Value	Setting the Alarm Upper Limit Value of Input Channel 3	
AI CH3 Lower Limit Value	Setting the Alarm Lower Limit Value of Input Channel 3	
AI CH4 Upper Limit Value	Setting the Alarm Upper Limit Value of Input Channel 4	

AI CH4 Lower Limit Value	Setting the Alarm Lower Limit Value of Input Channel 4	
AI CH1 Line Break Alarm	Enabled the Connection-Loss Alarm of Input Channel 1	0: Disable, the function is disabled (default); 1: Enable, the function is enabled.
AI CH2 Line Break Alarm	Enabled the Connection-Loss Alarm of Input Channel 2	
AI CH3 Line Break Alarm	Enabled the Connection-Loss Alarm of Input Channel 3	
AI CH4 Line Break Alarm	Enabled the Connection-Loss Alarm of Input Channel 4	
AO CH1 Range	Range Selection of Output Channel 1	16: -10.25~+10.25V (Default); 17: 0~10.25V 18: 0~5.125V 69: 0~21mA 68: 4~20mA
AO CH2 Range	Range Selection of Output Channel 2	
AO CH1 Overload Alarm	Enabled the Overload Alarm of Output Channel 1	0: Disable, the function is disabled (default); 1: Enable, the function is enabled.
AO CH2 Overload Alarm	Enabled the Overload Alarm of Output Channel 2	
AO CH1 Fault Mode Output	Selection of Output Channel 1 Fault Mode Output	0: Hold Last Value, retains output (default) 1: Fault Mode Output, outputs fault mode value
AO CH2 Fault Mode Output	Selection of Output Channel 2 Fault Mode Output	
AO CH1 Fault Mode Value	Fault Mode Value of Output Channel 1	Value range: 0 (default) ~65535
AO CH2 Fault Mode Value	Fault Mode Value of Output Channel 2	
AO CH1 Program Mode Output	Selection of Output Channel 1 Program Mode Output	0: Hold Last Value, retains output (default) 1: Program Mode value, outputs program mode value
AO CH2 Program Mode Output	Selection of Output Channel 2 Program Mode Output	
AO CH1 Program Mode Value	Program Mode Value of Output Channel 1	Value range: 0 (default) ~65535
AO CH2 Program Mode Value	Program Mode Value of Output Channel 2	

Table 7.9: List of LK810 User Parameters

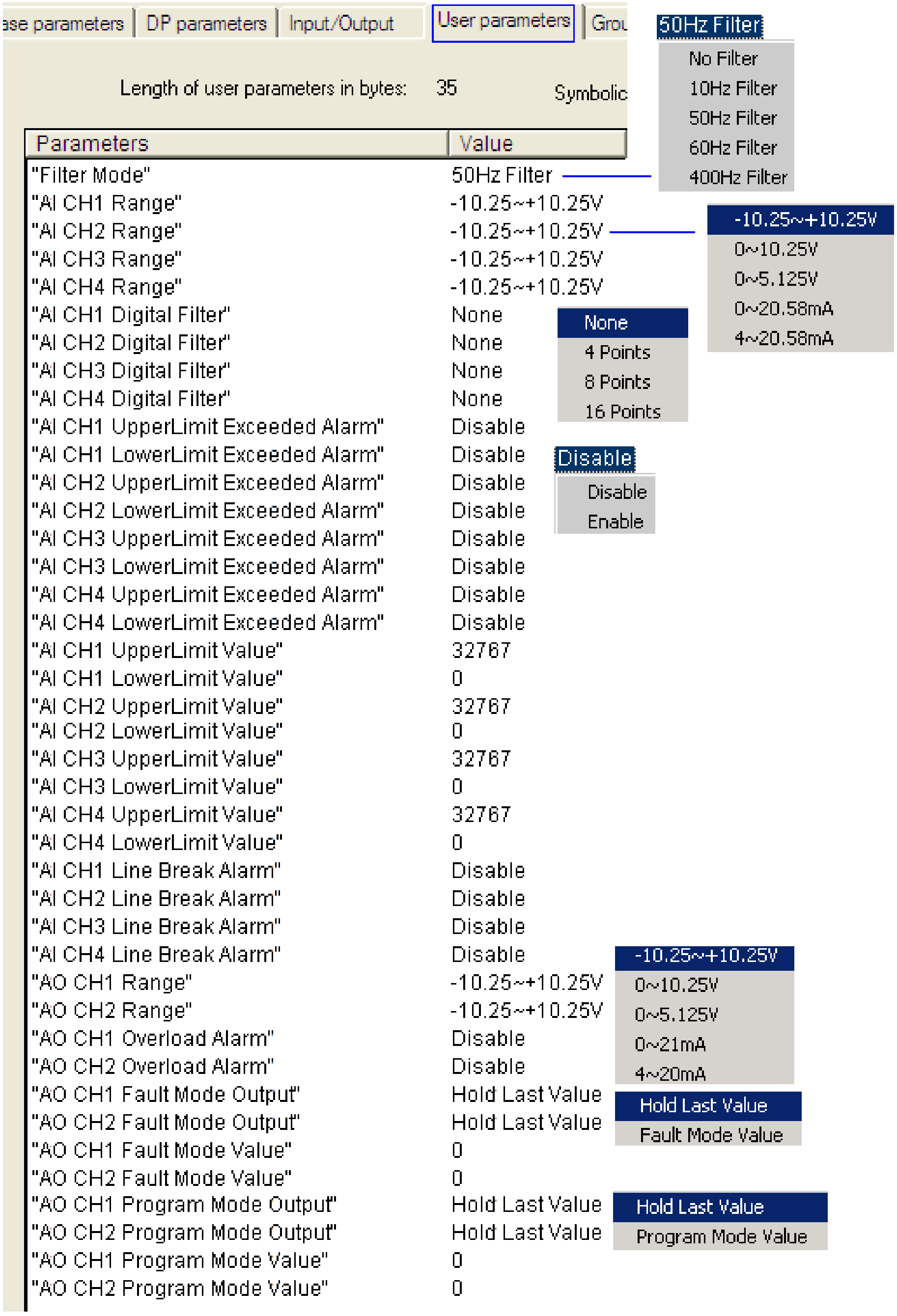


Figure 7.18: Setting of LK810 User Parameters

7.1.9 Module Installation and Un-installation

Refer to chapter 1 on "Module Insertion Mechanical keys" and "Module Insertion and Removable" for more details.

7.1.10 Technical Specification

LK810 Non-Isolation 4-Channel AI and 2-Channel Module				
Backplane Power Supply				
Input Voltage	24VDC(-15%~+20%)			
Power Consumption	150mA@24VDC			
Isolation Voltage				
Field to System	500V AC 1min Testing, Current Leak < 5mA			
Input Channel				
Number of Channels	4 channels of input and 2 channels of outputs			
Signal Type	Voltage or current			
Signal range	Range Code	Measurement Range	Decimal Code Value	Measurement precision after calibration (F.S. 50Hz filter)
Voltage Signal	16	0~+10.25V	0~32767	<0.1%
		-10.25V~1LSB	32768~65535	
	17	0~+10.25V	0~65535	<0.1%
	18	0~+5.125V	0~65535	<0.15%
Current Signal	71	4~20.58mA	0~65535	<0.15%
	70	0~20.58mA	0~65535	<0.15%
Input Impedance	Voltage Signal	>1MΩ		
	Current Signal	247Ω		
Differential Mode Suppression Rate	>60dB			
Integral Mode Suppression Rate	>100dB@50/60Hz			
Step Response Time	<1s			
Full Channel Scan Period (without software filter)	Hardware Filtering of 10Hz Interference	95ms;		
	Hardware Filtering of 50Hz Interference	410ms;		
	Hardware Filtering of 60Hz Interference	500ms;		
	Hardware Filtering of 400Hz Interference	1460ms;		
Calibration Period	12 months			
Temperature Drift (max.)	±25ppm/ºC			
Measurement Precision within Work Range	Range Code	Measurement Range		Measurement Precision (F.S, 50HZ Filter)
	16	-10.25~10.25V		<0.2%
	17	0~+10.25V		<0.2%
	18	0~+5.125V		<0.3%
	71	4~20.58mA		<0.3%
	70	0~20.58mA		<0.3%
Precision of Repeat	0.02%			
Output Channel				
Number of Channels	2 channels			
Signal Type	Voltage or current output			
Signal range	Range Code	Output Range	Decimal Code Value	Output Precision after Calibration (F.S.)
Voltage Signal	16	0~+10.25V	0~32767	<0.1%
		-10.25V~-1LSB	32768~65535	
	17	0~+10.25V	0~65535	<0.1%
	18	0~+5.125V	0~65535	<0.15%
Current Signal	68	4~20mA	0~65535	<0.15%
	69	0~21mA	0~65535	<0.15%
Output over-current protection	Only for current output, maximum output current <25mA			

Establishment Time (max.)	Resistance load	1ms;	
	Capacity load	1.5ms;	
	Inductance load	1.5ms;	
Drive Capability	Load	Voltage Output	Current Output
	Resistance load	>2000Ω	0~600Ω
	Capacity load	<1μF	-
	Inductance load	-	<1mH
Calibration Period	12 months		
Temperature Drift (max.)	±25ppm/ºC		
Output Precision within Work Range	Range Code	Output Range	Output Precision (F.S.)
	16	-10.25~+10.25V	<0.2%
	17	0~+10.25V	<0.2%
	18	0~+5.125V	<0.3%
	68	4~20mA	<0.3%
	69	0~21mA	<0.3%
Precision of Repeat	0.02%		
Failure Diagnosis and Hot swap			
Limit Exceeded Alarm Measurement Range Exceeded Alarm Line-Break Detection Over-load Detection (Voltage output: short circuit detected; Current output: line break detected.)	Input signal range exceeded Alarm upper/lower limits, diagnosis byte reports 0x07/0x08 Input signal range exceeded range upper/lower limits, diagnosis byte reports 0x03/0x02 Line-break occurs in the input channel, channel diagnosis byte reports 0x06 Output channel over-load, channel diagnosis byte reports 0x04		
Hot swap	Support		
Physical Features			
Mechanic Keys to Prevent Incorrect Insertion	F0		
Installation	Installation on backplane slot		
Installation Location	LK local backplane or expansion backplane		
Dimension	Width × Height × Depth = 35mm×100mm×100mm		
Casing Protection Level	IEC60529 IP20		
Weight	180g		
Working Environment			
Working temperature	0~60°C		
Working Relative Humidity	5%~95%, no condensate		
Storage Temperature	-40~70°C		
Storage Temperature	5%~95%, no condensate		

Table 7.10: Technical Specification of LK810 Module

Chapter

8

CHAPTER 8: DIGITAL INPUT MODULES

8.1 LK610 [16-CHANNEL 24VDC SINK DI MODULE]

8.1.1 Features

- 16 contacts of sink input
- Isolation between each field channel and the system
- Support ProfiBus-DP Slave Station Protocol
-
- Field Power Supply Voltage: 10VDC~31.2VDC
- Field Power Loss Detection
- Power supply reverse protection
- Supports hot swap

8.1.2 Operation Principles

Threshold Level of LK610:

- Logic 1: voltage range 10~31.2VDC, Current 2mA (10VDC) ~ 10mA (31.2VDC)
- Logic 0: maximum voltage 5VDC, maximum current 1.5mA

As shown in Figure 8.1, LK610 adopts sink input with the common ends of its 16 channels connected to the negative end of field-side power supply. One end of the switch connects the positive end of field-side power supply while the other end connects to the input end of DI channel. When the switch is closed, current goes into the optical coupler from the input end, and gets out of the common end to go back to the negative end of field-side power supply.

When input voltage is in the range of 10~31.2VDC, the Light Emitting Diode (LED) side of the optical coupler is connected and the trigger outputs a high voltage level; when input voltage is lower than or equals to 5VDC or the input current is smaller than or equals to 1.5mA, the LED side of the optical coupler is disconnected and the trigger outputs a low voltage level.

RC filter circuit filters and debounces the input voltage while the diode provides the reverse protection function.

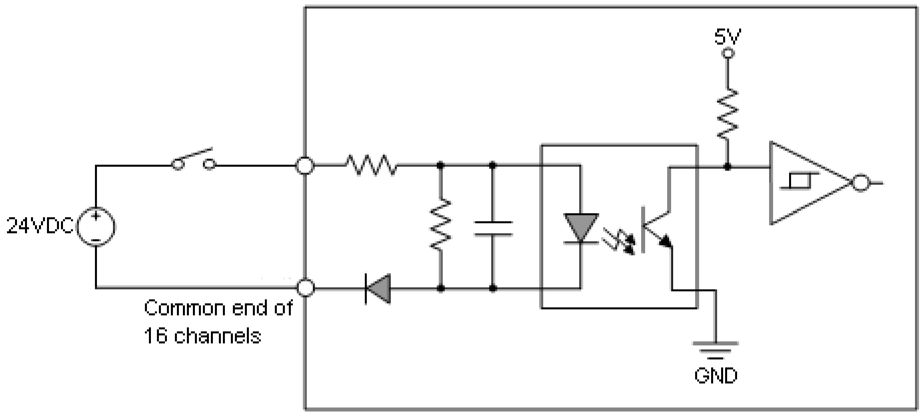


Figure 8.1: LK610 Channel Interface Circuit

8.1.3 Indicators Definition

RUN indicator (Green)	On	Communication is established, module in normal operation
	Flash	Communication is not established or communication error
	Off	Power off of the module
Channel01~16 Indicators (Yellow)	On	Channel close
	Off	Channel open

Table 8.1: Definition of LK610 Indicators

Specifications of RUN green light are as follows:

- After the power is on, the module waits for initialization data while the green light flashes with a frequency of 4 times per second.
- After the initialization is completed, the green light is constantly on to indicate the module in normal operation; if any error occurs in the initialization, then the communication is not established and the green light keeps flashing. Then, settings of communication parameters (slave station address, etc) shall be checked.
- Green light is constantly on in normal communications; green light flashes when communication breaks; green light returns to constant on when communication re-established.

8.1.4 Wiring Specifications

Adopting 16 channels of dry contact points, LK610 needs a field-side power supply to drive its optical coupler. To ensure the isolation between field and system, this 24VDC field-side power supply shall be separated from the backplane power supply.

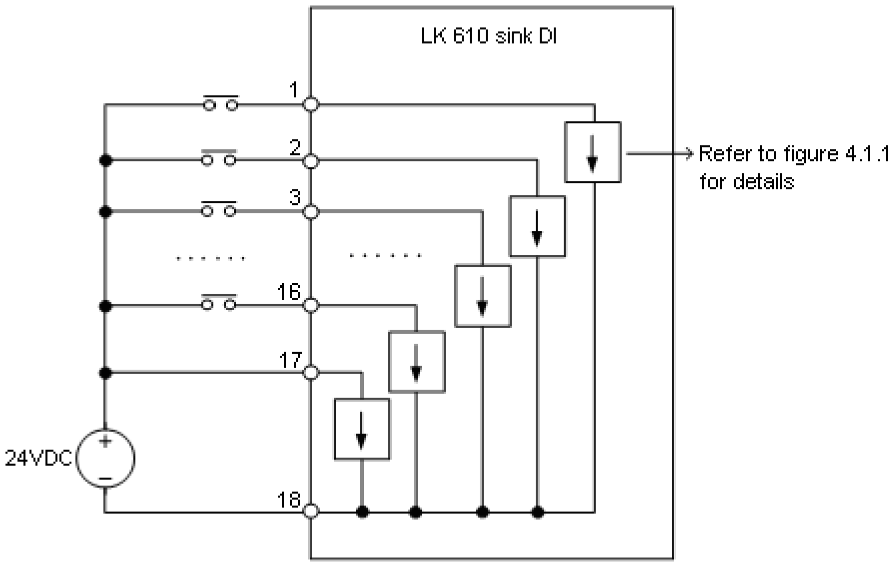


Figure 8.2: LK 610 Channel Interface of 16 Digital Inputs

LK610 module can be installed on either the LK local backplanes or the expansion backplanes. The LK series backplanes support two types of wrings: terminal wiring and prefabricated cable wring.

Wiring to Backplane Terminals

LK610 module is connected to field signals through the correspondence terminals under the local backplane installation slot. The relationship between each channel and terminal is shown in Figure 8.3. One ends of the 16 channel contacts connect to the wiring terminals (01~16) of the correspondence channels while the other ends connect to the positive end of field-side power supply.

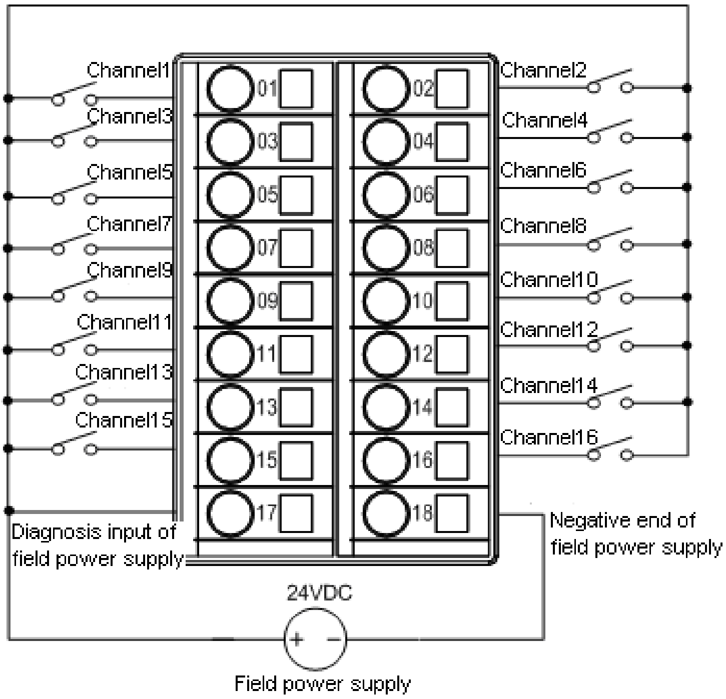


Figure 8.3: Wiring of LK610 Backplane Terminals

In the wiring, the following shall be noted:

- To ensure the electric isolation between the field and the system, LK610 need a separated external 24VDC field-side power supply (e.g., the 24VDC power supply on the backplane cannot be shared as the field power).
- The 24VDC field power supply is shared by all 16 channels.
- Terminal "1~16" are the dry contact digital input ends of Channel 1~16.
- Connected to the positive end of field power supply, Terminal "17" provides the diagnosis input for field power loss detection.
- Terminal "18" is the negative end of field power supply and the module's internal common end of Channel 1~16.
- A single terminal shall not be connected to many wires; therefore multiple-point connection can be established through bus bar or transferring terminal board.

Wiring to Terminal Modules

Please refer to the information found on Chapter 12: Terminal Module.

8.1.5 Diagnosis Specifications

PowerPro V4 configuration software adopts external diagnosis library to check and acquire all kinds of diagnosis information, such as whether the module and its channels are operating normally, whether the field power supplying smoothly and whether the module parameters are set correctly.

For the DP slave station modules, the DP slave station expansion diagnosis function block (HS_DPSlaveALarm) shall be called to check the DP module at any address (DP_Addr) on the PROFIBUS-DP link, as shown in Figure 8.4.

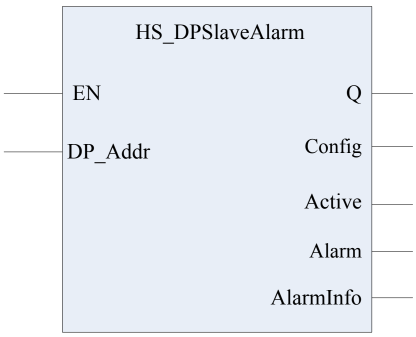


Figure 8.4: Expansion Diagnosis Function Block for DP Slave Station

For detailed usage of DP Expansion Diagnosis Function Block, please refer to LK Large Scale PLC Instruction Manual. Users shall note that the Diagnosis library is an external library that shall be first installed in the Library Manager before use.

The diagnosis information of DP slave station modules can be classified to 3 categories:

- device diagnosis
- identifier diagnosis
- channel diagnosis.

All diagnosis data exist in the form of block structure.

Field Power Loss Detection

LK610 provides the field power loss detection. Whether to enable this function can be selected by user parameter “FieldPowerLossDetection”, the default setting of which is “Enable”. Modifications can only be effective after the full download.

As shown in Figure 8.5, terminal “17” connects to the positive end of field power supply while terminal “18” connects to its negative end. LK610 carries out power loss detection by checking the changes of input voltage between these two terminals. In case of any failure, the failure status will be reported to the controller as the diagnosis data.

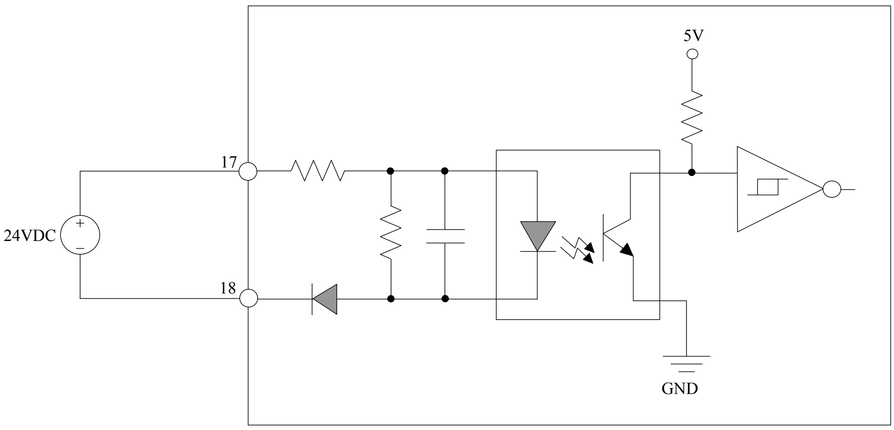


Figure 8.5: Field Power Loss Detection Circuit of LK610

- When the field power supply voltage is in the range of 10~31.2VDC, the optical coupler switch of power loss detection channel is “ON” to indicate that field power supply is normal; when the field power supply voltage is lower than 5VDC, the optical coupler switch of power loss detection channel is “OFF” to indicate the field power loss; when the field power supply voltage I sin the range of 5~10VDC, the status of the optical coupler switch is not determined.
- When the field 24VDC power supply is lost (line-break or power supply output voltage <5VDC), LK610 device diagnosis data area generate diagnosis byte “0x04” (Bit2 of this diagnosis byte =1), and reports this diagnosis byte to the controller in the next scan period.
- When the field 24VDC power supply is recovered (power supply output voltage in range 10~31.2VDC), LK610 device diagnosis data area generates a new diagnosis byte “0x00” (Bit2 of this diagnosis byte =0), and reports this diagnosis byte to the controller in the next scan period.

LK610 module will only report the diagnosis data once respectively when failure occurs and is recovered.

Field power loss detection is a kind of device diagnosis. The definition of its diagnosis byte is as shown in Figure 8.6. After the DP slave station expansion diagnosis function block is called, the diagnosis data reported by LK610 will be stored in the output field "DevDiag.Data.Data[1]" of the function block output parameter “AlarmInfo”, as shown in Table 8.2.

Device diagnosis

0	0	0	0	0	Bit2	0	Bit0

=1,loss of field power supply
=0,failure recovered

Figure 8.6: LK610 Diagnosis Byte

Device Diagnosis	Value	Definition
AlarmInfo.DevDiag.Data.Data[1]	0X04	Power Loss of Field Power Supply
	0x00	Failure recovered or no diagnosis data

Table 8.2: Definition of LK610 Diagnosis Information

Reverse Protection

LK610 module connects a diode in series at the negative end of input power for the reverse protection that prevent damages to the module when there is any wrong wirings of external power supply.

Maximum reverse voltage is 60VDC.

8.1.6 Parameter Specifications

The controller can only read and write the I/O information regularly after it entered data exchange mode. Therefore, in order to provide correct parameter information in the initialization process, users shall first set the hardware parameters in the configuration software PowerPro V4.

Communication Parameters

Supporting PROFIBUS-DP slave station protocol, LK610 completes data exchanges and diagnosis information reporting with the controller and other DP master stations. The slave station adopts a unique communication address, which is determined by the backplane number and the slot number of the LK610 module. In configuration, the correct communication address of the module shall be written in the DP parameter. Normally, other parameters do not need any modification, as shown in Figure 8.7.

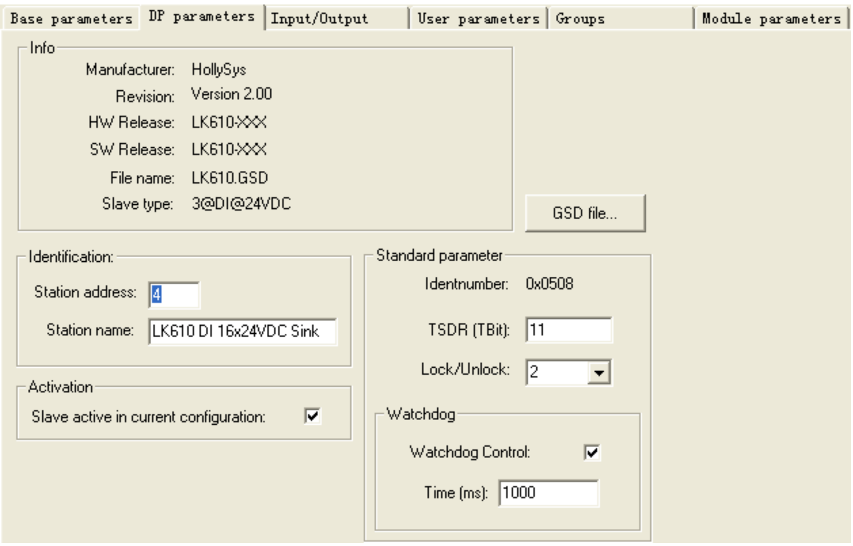


Figure 8.7: Setting of LK610 Communication Parameters

User Parameters

User parameters are used to configure the module's operating mode. They are written into the controller during the download of user program and will not be read in every scanning circle. Each parameter has a default value that can be changed according to requirements of the project. Modifications of parameter values can only be effective after the full download.

LK610 has totally 2 bytes of user parameters, as shown in Table 8.3.

<table>
<tr><th>Parameter Name</th><th>Parameter Definition</th><th>Parameter Value</th></tr>
<tr><td>OFF to ON Filter Time</td><td>OFF→ON filter time</td><td rowspan="2">0=1ms
1=3ms
2=5ms (Default)
3=10ms
4=15ms
5=20ms
6=25ms
7=30ms</td></tr>
<tr><td>ON to OFF Filter Time</td><td>ON→OFF filter time</td></tr>
</table>

Field Power Loss Detection	Enable Field Power Supply Loss Detection	0=Disable, the function is disabled; 1=Enable, the function is enabled (default);

Table 8.3: Definition of LK610 User Parameters

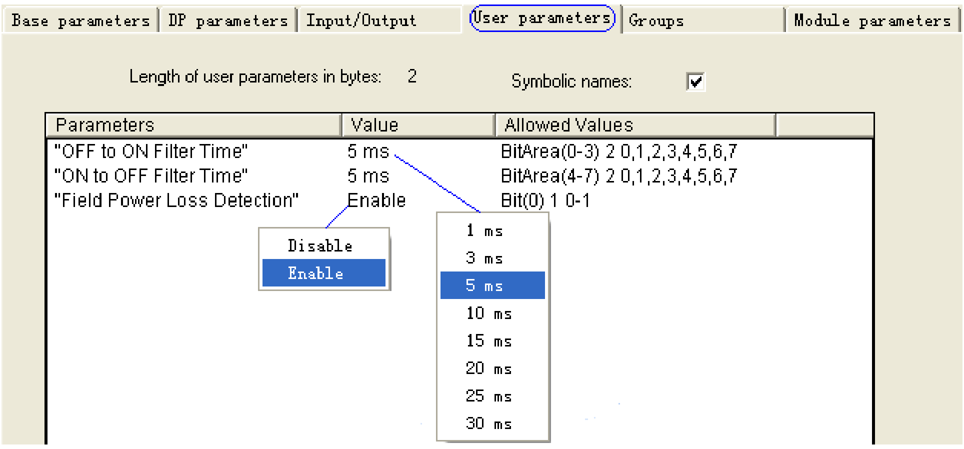


Figure 8.8: Setting of LK610 User Parameters

8.1.7 Module Installation and Un-installation

Refer to chapter 1 on "Module Insertion Mechanical keys" and "Module Insertion and Removable" for more details.

8.1.8 Technical Specification

LK610 16-Channel 24VDC Sink DI module		
System Power Supply		
System Power Supply Voltage		24VDC(-15%~+20%)
System Power Consumption		50mA max@24VDC, exclusive of field power consumption
Input Channel		
Number of Channels		16
Contact Point Type		Dry contact, sink input
Field Power Supply Rated Voltage		24VDC
Channel Closure Rated Voltage		7mA@24VDC
Threshold voltage Level(Vth)	ON	10VDC(2mA)~31.2VDC(10mA)
	OFF	0~5VDC(1.5mA)
Debounce filter time OFF→ON ON→OFF		Configuration options: 1ms, 3ms, 5ms, 10ms, 15ms, 20ms, 25ms, 30ms Configuration options: 1ms, 3ms, 5ms, 10ms, 15ms, 20ms, 25ms, 30ms
Reverse Protection		Maximum Voltage 60VDC
Isolation Voltage between Field and System		500VAC@1min, Current Leak 5mA
Failure Diagnosis and Hot Swap		
Field-side power loss diagnosis		Bit2 of the diagnosis byte (Bit0~Bit7) reported by the module provides the diagnosis information of field-side power supply. Bit2=1 indicates field power loss while Bit2=0 indicates field-side power loss recovered. Field power supply failure diagnosis is only reported once respectively when the failure occurs and when it is recovered.
Hot Swap		Support
Communication Bus		
Protocol		PROFIBUS-DP Slave Station, in accordance with IEC61158-3/EN50170 standards
Baud Rate		Baud Rate Options: 1.5Mbps, 500Kbps, 187.5Kbps, 93.75Kbps, 45.45Kbps, 31.25Kbps, 19.2Kbps, 9.6Kbps
Media		Communication bus is connected to the backplane through euro connector, hot redundant communication media
Physical Features		
Mechanic Keys to Prevent Incorrect Insertion		D0
Installation Location		LK local backplane or expansion backplane
Dimension		Width × Height × Depth = 35mm×100mm×100mm
Casing Protection Level		IEC60529 IP20
Weight		180g
Working Environment		
Working Temperature		0℃~60℃
Working Relative Humidity		5%~95%, no condensate
Storage Temperature		-40℃~70℃
Storage relative Humidity		5%~95%, no condensate

Table 8.4: Technical Specification of LK610 Module

8.2 LK611 [16-CHANNEL 24VDC SOURCE DI MODULE]

8.2.1 Features

- 16 contacts of source input
- Isolation between each field channel and the system
- Support ProfiBus-DP Slave Station Protocol
-
- Field Power Supply Voltage: 10VDC~31.2VDC
- Field Power Loss Detection
- Power supply reverse protection
- Supports hot swap

8.2.2 Operation Principles

Threshold Level of LK611:

- Logic 1: voltage range 10~31.2VDC, Current 2mA (10VDC) ~ 10mA (31.2VDC)
- Logic 0: maximum voltage 5VDC, maximum current 1.5mA

As shown in Figure 8.9, LK611 adopts source input with the common ends of its 16 channels connected to the positive end of field power supply. One end of the switch connects the negative end of field power supply while the other end connects to the input end of DI channel. When the switch is closed, current goes into the optical coupler from the common end, and gets out of the input end to go back to the negative end of field power supply through the switch.

- When input voltage is in the range of 10~31.2VDC, the Light Emitting Diode (LED) side of the optical coupler is connected and the trigger outputs a high voltage level; when input voltage is lower than or equals to 5VDC or the input current is smaller than or equals to 1.5mA, the LED side of the optical coupler is disconnected and the trigger outputs a low voltage level.
- RC filter circuit filters and debounces the input voltage while the diode provides the reverse protection function.

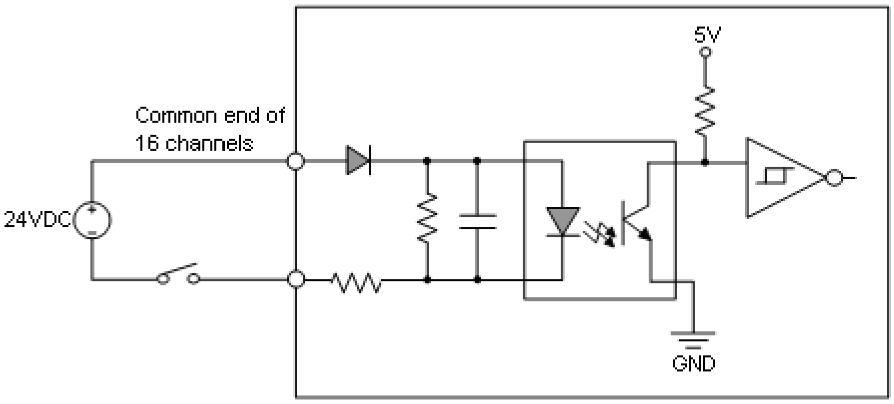


Figure 8.9: LK611 Channel Interface Circuit

8.2.3 Indicators Definition

RUN indicator (Green)	On	Communication is established, module in normal operation
	Flash	Communication is not established or communication error
	Off	Power off of the module
Channel01~16 Indicators (Yellow)	On	Channel closed
	Off	Channel is disconnected

Table 8.5: Definition of LK611 Indicators

Specifications of RUN green light are as follows:

- After the power is on, the module waits for initialization data while the green light flashes with a frequency of 4 times per second.
- After the initialization is completed, the green light is constantly on to indicate the module in normal operation; if any error occurs in the initialization, then the communication is not established and the green light keeps flashing. The connection of DP cables and communication parameters settings then shall be checked to see if there are any errors.
- When the module is in normal operation, the green light is constantly on. When communication halts, the green light will flash, when communication is re-established, the green light will be on again.

8.2.4 Wiring Specifications

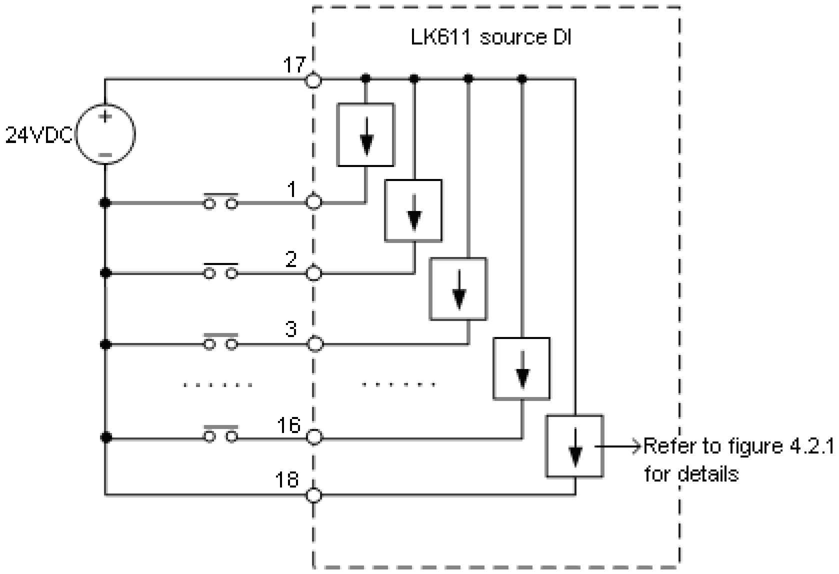


Figure 8.10: LK 611 Channel Interface of 16 Digital Inputs

Adopting 16 channels of dry contact points, LK611 needs a field-side power supply to drive its optical coupler. To ensure the isolation between field and system, this 24VDC field-side power supply shall be separated from the backplane power supply.

LK611 module can be installed on either the LK local backplanes or the expansion backplanes. The LK series backplanes support two types of wrings: terminal wiring and prefabricated cable wring.

Wiring to Backplane Terminals

- LK611 module is connected to field signals through the correspondence terminals under the local backplane installation slot. The relationship between each channel and terminal is shown in Figure 8.11. One ends of the 16 channel contacts connect to the wiring terminals (01~16) of the correspondence channels while the other ends connect to the negative end of field power supply.

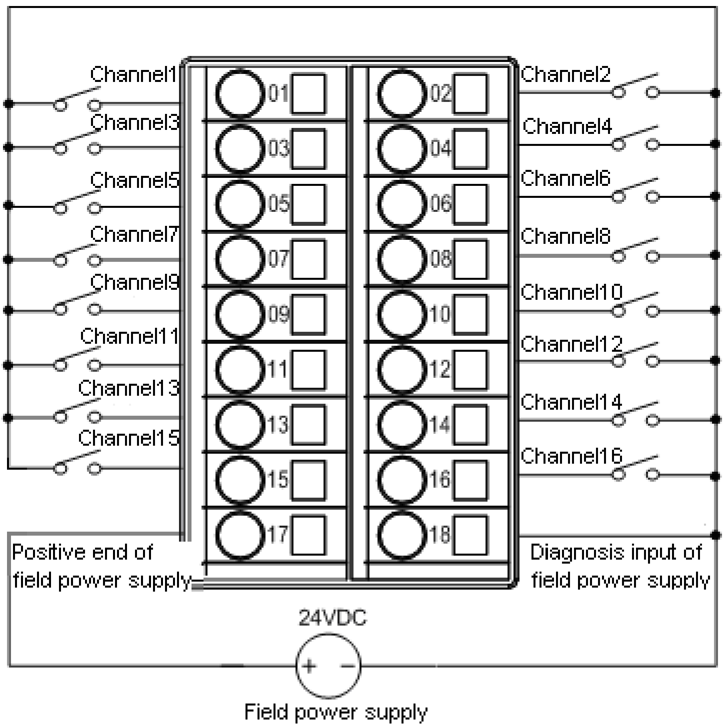


Figure 8.11: Wiring of LK611 Backplane Terminals

In the wiring, the following shall be noted:

- To ensure the electric isolation between the field and the system, LK611 need a separated external 24VDC field power supply (e.g., the 24VDC power supply on the backplane cannot be shared as the field power).
- The 24VDC field power supply is shared by all 16 channels.
- Terminal "1~16" are the dry contact digital input ends of Channel 1~16.
- Terminal "17" connects to the positive end of field power supply and is the module's internal common end of Channel 1~16.
- Terminal "18" can connect to the negative end of field power supply for the field power loss detection.
- A single terminal shall not be connected to many wires; therefore multiple-point connection can be established through bus bar or transferring terminal board.

Wiring to Terminal Modules

Please refer to the information found on Chapter 12: Terminal Module.

8.2.5 Diagnosis Specifications

PowerPro V4 configuration software adopts external diagnosis library to check and acquire all kinds of diagnosis information, such as whether the module and its channels are operating normally, whether the field power supplying smoothly and whether the module parameters are set correctly.

For the DP slave station modules, the DP slave station expansion diagnosis function block (HS_DPSlaveALarm) shall be called to check the DP module at any address (DP_Addr) on the PROFIBUS-DP link, as shown in Figure 8.12.

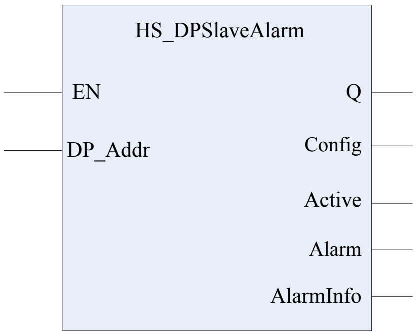


Figure 8.12: Expansion Diagnosis Function Block for DP Slave Station

For detailed usage of DP Expansion Diagnosis Function Block, please refer to LK Large Scale PLC Instruction Manual. Users shall note that the Diagnosis library is an external library that shall be first installed in the Library Manager before use.

The diagnosis information of DP slave station modules can be classified to 3 categories:

- device diagnosis
- identifier diagnosis
- channel diagnosis.

All diagnosis data exist in the form of block structure.

Field Power Loss Detection

LK611 provides the field power loss detection. Whether to enable this function can be selected by user parameter "FieldPowerLossDetection", the default setting of which is "Enable". Modifications can only be effective after the full download.

As shown in Figure 8.13, terminal "17" connects to the positive end of field power supply while terminal "18" connects to its negative end. LK611 carries out power loss detection by checking the changes of input voltage between these two terminals. In case of any failure, the failure status will be reported to the controller as the diagnosis data.

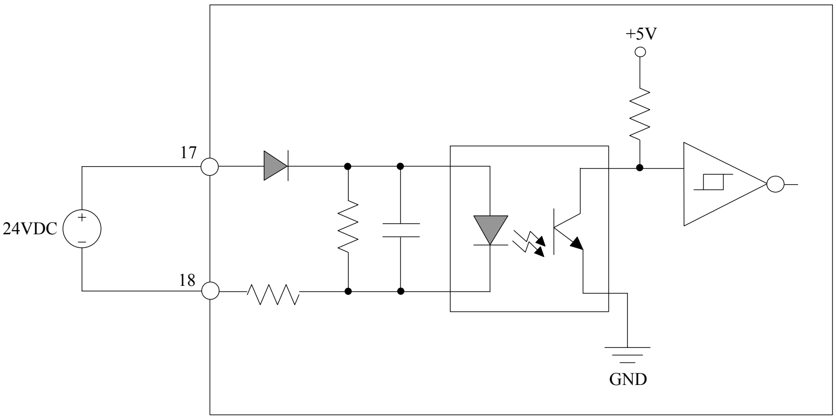


Figure 8.13: Field Power Loss Detection Circuit of LK611

- When the field power supply voltage is in the range of 10~31.2VDC, the optical coupler switch of power loss detection channel is "ON" to indicate that field power supply is normal; when the field power supply voltage is lower than 5VDC, the optical coupler switch of power loss detection channel is "OFF" to indicate the field power loss; when the field power supply voltage I sin the range of 5~10VDC, the status of the optical coupler switch is not determined.
- When the field 24VDC power supply is lost (line-break or power supply output voltage <5VDC), LK611 device diagnosis data area generate diagnosis byte "0x04" (Bit2 of this diagnosis byte =1), and reports this diagnosis byte to the controller in the next scan period.
- When the field 24VDC power supply is recovered (power supply output voltage in range 10~31.2VDC), LK611 device diagnosis data area generates a new diagnosis byte "0x00" (Bit2 of this diagnosis byte =0), and reports this diagnosis byte to the controller in the next scan period.

LK611 module will only report the diagnosis data once respectively when failure occurs and is recovered.

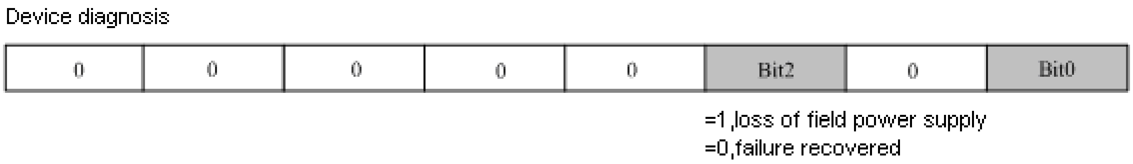


Figure 8.14: LK611 Diagnosis Byte

Field power loss detection is a kind of device diagnosis. The definition of its diagnosis byte is as shown in Figure 8.14. After the DP slave station expansion diagnosis function block is called, the diagnosis data reported by LK611 will be stored in the output field "DevDiag.Data.Data[1]" of the function block output parameter "AlarmInfo", as shown in Table 8.6.

Device Diagnosis	Value	Definition
AlarmInfo.DevDiag.Data.Data[1]	0X04	Power Loss of Field Power Supply
	0x00	Failure recovered or no diagnosis data

Table 8.6: Definition of LK611 Diagnosis Information

Reverse Protection

LK611 module connects a diode in series at the negative end of input power for the reverse protection that prevent damages to the module when there is any wrong wirings of external power supply.

Maximum reverse voltage is 60VDC.

8.2.6 Parameter Specifications

The controller can only read and write the I/O information regularly after it entered data exchange mode. Therefore, in order to provide correct parameter information in the initialization process, users shall first set the hardware parameters in the configuration software PowerPro V4.

Communication Parameters

- Supporting PROFIBUS-DP slave station protocol, LK611 completes data exchanges and diagnosis information reporting with the controller and other DP master stations. The slave station adopts a unique communication address, which is determined by the backplane number and the slot number of the LK611 module. In configuration, the correct

communication address of the module shall be written in the DP parameter. Normally, other parameters do not need any modification, as shown in Figure 8.15.

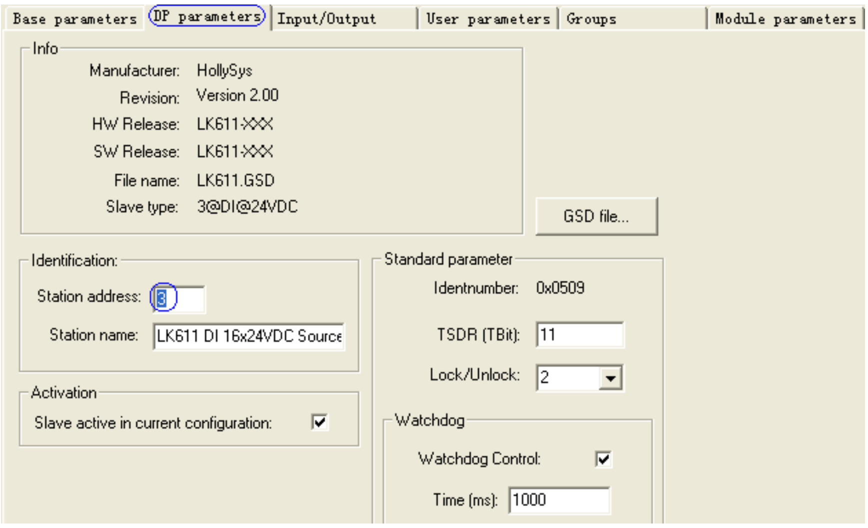


Figure 8.15: Setting of LK611 Communication Parameters

User Parameters

- User parameters are used to configure the module's operating mode. They are written into the controller during the download of user program and will not be read in every scanning circle. Each parameter has a default value that can be changed according to requirements of the project. Modifications of parameter values can only be effective after the full download.
- LK611 has totally 2 bytes of user parameters, as shown in Table 8.7.

Parameter Name	Parameter Definition	Parameter Value
OFF to ON Filter Time	OFF→ON filter time	0=1ms 1=3ms 2=5ms (Default) 3=10ms 4=15ms 5=20ms 6=25ms 7=30ms
ON to OFF Filter Time	ON→OFF filter time	
Field Power Loss Detection	Enable Field Power Supply Loss Detection	0=Disable, the function is disabled; 1=Enable, the function is enabled (default);

Table 8.7: Definition of LK611 User Parameters

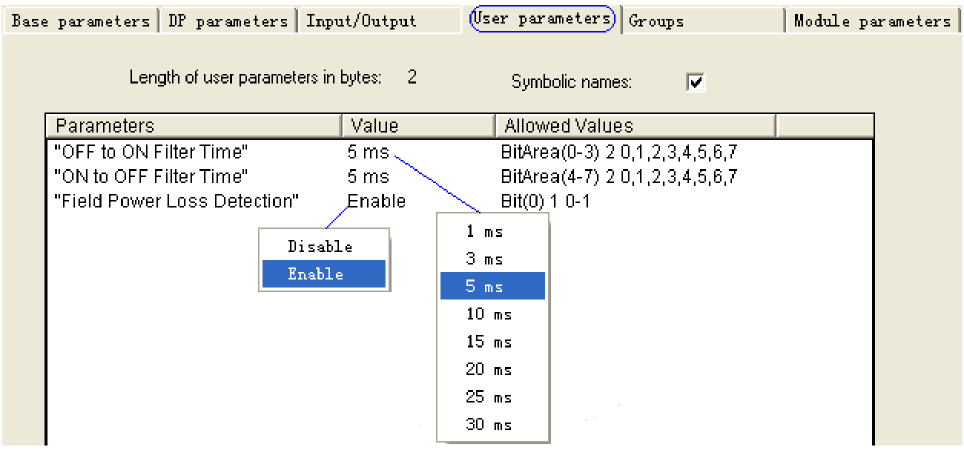


Figure 8.16: Setting of LK611 User Parameters

8.2.7 Module Installation and Un-installation

Refer to chapter 1 on "Module Insertion Mechanical keys" and "Module Insertion and Removable" for more details.

8.2.8 Technical Specification

LK611 16-Channel 24VDC Source DI module		
System Power Supply		
System Power Supply Voltage		24VDC(-15%~+20%)
System Power Consumption		50mA max@24VDC, exclusive of field power consumption
Input Channel		
Number of Channels		16
Contact Point Type		Dry contact, source input
Field Power Supply Rated Voltage		24VDC
Channel Closure Rated Voltage		7mA@24VDC
Threshold voltage Level(Vth)	ON	10VDC(2mA)~31.2VDC(10mA)
	OFF	0~5VDC(1.5mA)
Debounce filter time OFF→ON ON→OFF		Configuration options: 1ms, 3ms, 5ms, 10ms, 15ms, 20ms, 25ms, 30ms Configuration options: 1ms, 3ms, 5ms, 10ms, 15ms, 20ms, 25ms, 30ms
Reverse Protection		Maximum Voltage 60VDC
Isolation Voltage between Field and System		500VAC@1min, Current Leak 5mA
Failure Diagnosis and Hot Swap		
Field-side power loss diagnosis		Bit2 of the diagnosis byte (Bit0~Bit7) reported by the module provides the diagnosis information of field-side power supply. Bit2=1 indicates field power loss while Bit2=0 indicates field-side power loss recovered. Field power supply failure diagnosis is only reported once respectively when the failure occurs and when it is recovered.
Hot Swap		Support
Communication Bus		
Protocol		PROFIBUS-DP Slave Station, in accordance with IEC61158-3/EN50170 standards
Baud Rate		Baud Rate Options: 1.5Mbps, 500Kbps, 187.5Kbps, 93.75Kbps, 45.45Kbps, 31.25Kbps, 19.2Kbps, 9.6Kbps
Media		Communication bus is connected to the backplane through euro connector, hot redundant communication media
Physical Features		
Mechanic Keys to Prevent Incorrect Insertion		D0
Installation Location		LK local backplane or expansion backplane
Dimension		Width × Height × Depth = 35mm×100mm×100mm
Casing Protection Level		IEC60529 IP20
Weight		180g
Working Environment		
Working Temperature		0℃~60℃
Working Relative Humidity		5%~95%, no condensate
Storage Temperature		-40℃~70℃
Storage relative Humidity		5%~95%, no condensate

Table 8.8: Technical Specification of LK611 Module

8.3 LK612 [16-CHANNEL 48VDC SOURCE DI MODULE]

8.3.1 Features

- 16 contacts of source input
- Range of Field Voltage: 30VDC~60VDC
- System-to-Field Isolation
-
- Field Power Loss Detection
- Power supply reverse protection
- Support ProfiBus-DP Slave Station Protocol
- Supports hot swap

8.3.2 Operation Principles

Threshold Level of LK612:

- Logic 1: voltage range 30~60VDC, Current 2mA (30VDC) ~ 7mA (60VDC)
- Logic 0: maximum voltage 10VDC, maximum current 1.5mA

As shown in Figure 8.17, LK612 adopts source input with the common ends of its 16 channels connected to the positive end of field power supply. One end of the switch connects the negative end of field power supply while the other end connects to the input end of DI channel. When the switch is closed, current goes into the optical coupler from the common end, and gets out of the input end to go back to the negative end of field power supply through the switch.

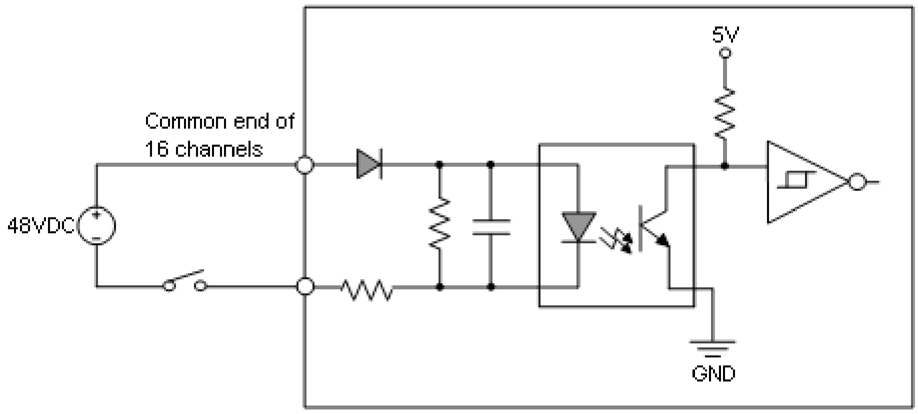


Figure 8.17: LK612 Channel Interface Circuit

- When input voltage is in the range of 30~60VDC, the Light Emitting Diode (LED) side of the optical coupler is connected and the trigger outputs a high voltage level; when input voltage is lower than or equals to 10VDC or the input current is smaller than or equals to1.5mA, the LED side of the optical coupler is disconnected and the trigger outputs a low voltage level.
- RC filter circuit filters and debounces the input voltage while the diode provides the reverse protection function.

8.3.3 Indicators Definition

RUN indicator (Green)	On	Communication is established, module in normal operation
	Flash	Communication is not established or communication error
	Off	Power off of the module
Channel01~16 Indicators (Yellow)	On	The channel is connected
	Off	Channel is disconnected

Table 8.9: Definition of LK612 Indicators

Specifications of RUN green light are as follows:

- After the power is on, the module waits for initialization data while the green light flashes with a frequency of 4 times per second.
- After the initialization is completed, the green light is constantly on to indicate the module in normal operation; if any error occurs in the initialization, then the communication is not established and the green light keeps flashing. The connection of DP cables and communication parameters settings then shall be checked to see if there are any errors.
- When the module is in normal operation, the green light is constantly on. When communication halts, the green light will flash, when communication is re-established, the green light will be on again.

8.3.4 Wiring Specifications

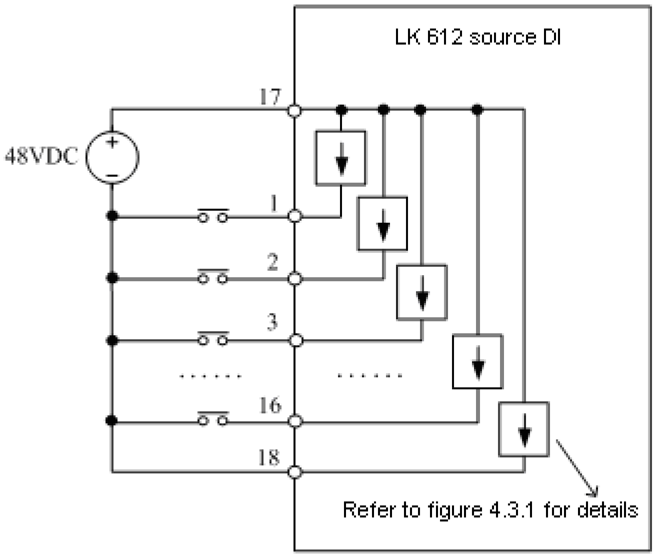


Figure 8.18: LK612 Channel Interface of 16 Digital Inputs

Adopting 16 channels of dry contact points, LK612 needs a field power supply to drive its optical coupler. To ensure the isolation between field and system, this 48VDC field power supply shall be separated from the backplane power supply.

LK612 module can be installed on either the LK local backplanes or the expansion backplanes. The LK series backplanes support two types of wrings: terminal wiring and prefabricated cable wring.

Wiring to Backplane Terminals

LK612 module is connected to field signals through the correspondence terminals under the local backplane installation slot. The relationship between each channel and terminal is shown in Figure 8.19. One ends of the 16 channel contacts connect to the wiring terminals (01~16) of the correspondence channels while the other ends connect to the negative end of field power supply.

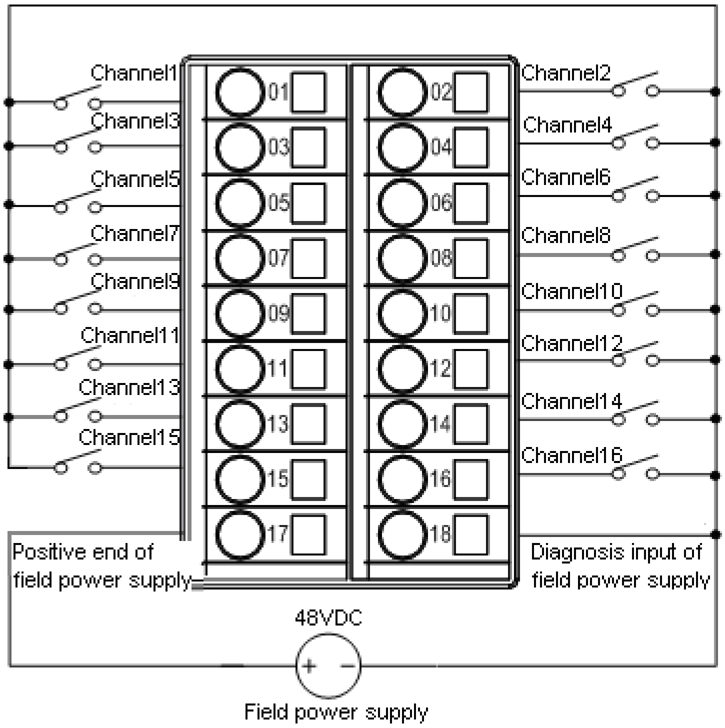


Figure 8.19: Wiring of LK612 Backplane Terminals

In the wiring, the following shall be noted:

- LK612 shall connect to a separated external 48VDC field power supply to ensure the electric isolation between the system and the field.
- The 48VDC field power supply is shared by all 16 channels.
- Terminal "1~16" are the dry contact digital input ends of Channel 1~16.
- Terminal "17" connects to the positive end of field power supply and is the module's internal common end of Channel 1~16.
- Terminal "18" can connect to the negative end of field power supply for the field power loss detection.
- A single terminal shall not be connected to many wires; therefore multiple-point connection can be established through bus bar or transferring terminal board.

Wiring to Terminal Modules

Please refer to the information found on Chapter 12: Terminal Module.

8.3.5 Diagnosis Specifications

PowerPro V4 configuration software adopts external diagnosis library to check and acquire all kinds of diagnosis information, such as whether the module and its channels are operating normally, whether the field power supplying smoothly and whether the module parameters are set correctly.

For the DP slave station modules, the DP slave station expansion diagnosis function block (HS_DPSlaveALarm) shall be called to check the DP module at any address (DP_Addr) on the PROFIBUS-DP link, as shown in Figure 8.20.

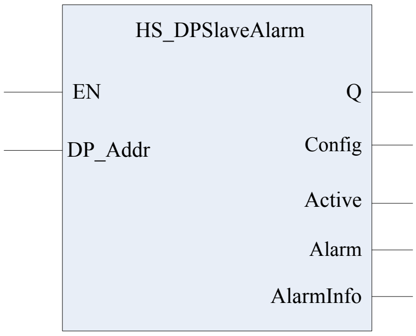


Figure 8.20: Expansion Diagnosis Function Block for DP Slave Station

For detailed usage of DP Expansion Diagnosis Function Block, please refer to LK Large Scale PLC Instruction Manual. Users shall note that the Diagnosis library is an external library that shall be first installed in the Library Manager before use.

The diagnosis information of DP slave station modules can be classified to 3 categories:

- device diagnosis
- identifier diagnosis
- channel diagnosis

All diagnosis data exist in the form of block structure.

Field Power Loss Detection

LK612 provides the field power loss detection. Whether to enable this function can be selected by user parameter "FieldPowerLossDetection", the default setting of which is "Enable". Modifications can only be effective after the full download.

As shown in Figure 8.21, terminal "17" connects to the positive end of field power supply while terminal "18" connects to its negative end. LK612 carries out power loss detection by checking the changes of input voltage between these two terminals. In case of any failure, the failure status will be reported to the controller as the diagnosis data.

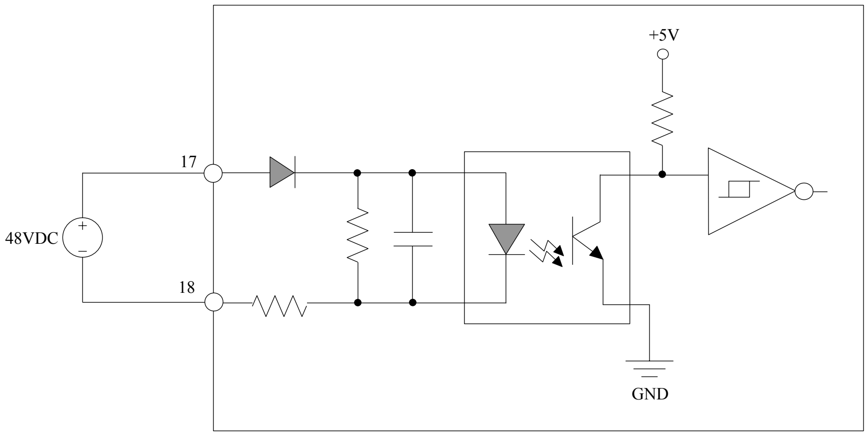


Figure 8.21: Field Power Loss Detection Circuit of LK612

- When the field power supply voltage is in the range of 30~60VDC, the optical coupler switch of power loss detection channel is "ON" to indicate that field power supply is normal; when the field power supply voltage is lower than 10VDC, the optical coupler switch of power loss detection channel is "OFF" to indicate the field power loss; when the field power supply voltage I sin the range of 10~30VDC, the status of the optical coupler switch is not determined.
- When the field 48VDC power supply is lost (line-break or power supply output voltage <10VDC), LK612 device diagnosis data area generates diagnosis byte "0x04" (Bit2 of this diagnosis byte =1), and reports this diagnosis byte to the controller in the next scan period.
- When the field 48VDC power supply is recovered (power supply output voltage in range 30~60VDC), LK612 device diagnosis data area generates a new diagnosis byte "0x00" (Bit2 of this diagnosis byte =0), and reports this diagnosis byte to the controller in the next scan period.

LK612 module will only report the diagnosis data once respectively when failure occurs and is recovered.

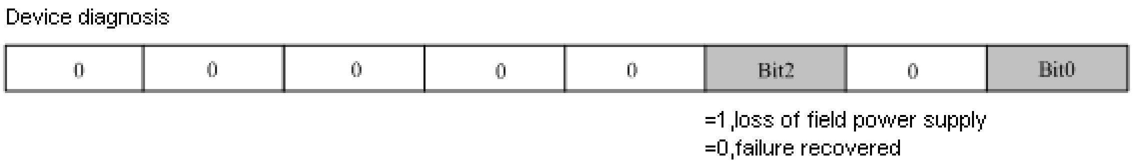


Figure 8.22: LK612 Diagnosis Byte

Field power loss detection is a kind of device diagnosis. The definition of its diagnosis byte is as shown in Figure 8.22. After the DP slave station expansion diagnosis function block is called, the diagnosis data reported by LK612 will be stored in the output field "DevDiag.Data.Data[1]" of the function block output parameter "AlarmInfo", as shown in Table 8.10.

Device Diagnosis	Value	Definition
AlarmInfo.DevDiag.Data.Data[1]	0X04	Power Loss of Field Power Supply
	0x00	Failure recovered or no diagnosis data

Table 8.10: Definition of LK612 Diagnosis Information

Reverse Protection

LK612 module connects a diode in series at the negative end of input power for the reverse protection that prevent damages to the module when there is any wrong wirings of external power supply.

Maximum reverse voltage is 100VDC.

8.3.6 Parameter Specifications

The controller can only read and write the I/O information regularly after it entered data exchange mode. Therefore, in order to provide correct parameter information in the initialization process, users shall first set the hardware parameters in the configuration software PowerPro V4.

Communication Parameters

- Supporting PROFIBUS-DP slave station protocol, LK612 completes data exchanges and diagnosis information reporting with the controller and other DP master stations. The slave station adopts a unique communication address, which is determined by the backplane number and the slot number of the LK612 module. In configuration, the correct

communication address of the module shall be written in the DP parameter. Normally, other parameters do not need any modification, as shown in Figure 8.23.

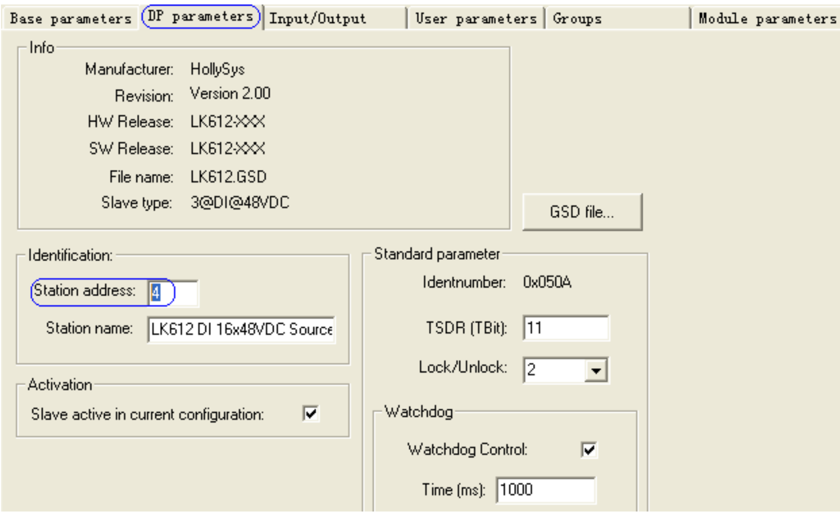


Figure 8.23: Setting of LK612 Communication Parameters

User Parameters

- User parameters are used to configure the module's operating mode. They are written into the controller during the download of user program and will not be read in every scanning circle. Each parameter has a default value that can be changed according to requirements of the project. Modifications of parameter values can only be effective after the full download.
- LK612 has totally 2 bytes of user parameters, as shown in Table 8.11.

Parameter Name	Parameter Definition	Parameter Value
OFF to ON Filter Time	OFF→ON filter time	0=1ms 1=3ms 2=5ms (Default) 3=10ms 4=15ms 5=20ms 6=25ms 7=30ms
ON to OFF Filter Time	ON→OFF filter time	
Field Power Loss Detection	Enable Field Power Supply Loss Detection	0=Disable, the function is disabled; 1=Enable, the function is enabled (default);

Table 8.11: Definition of LK612 User Parameters

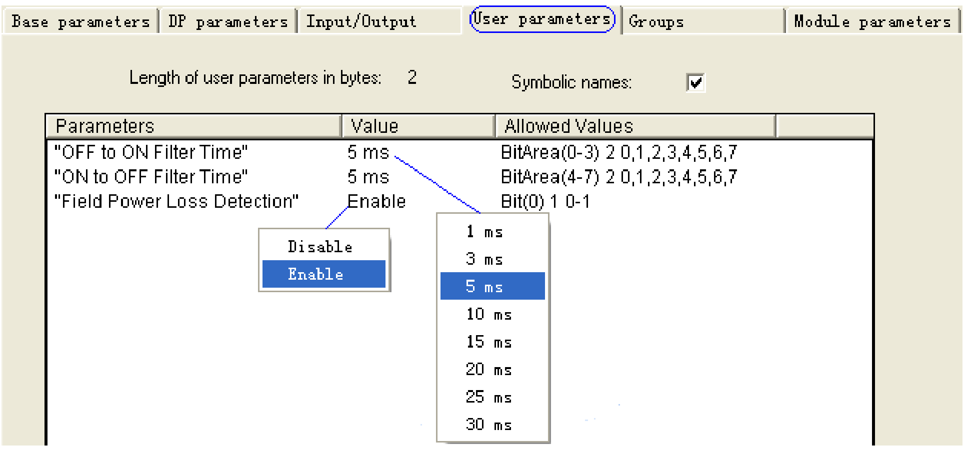


Figure 8.24: Setting of LK612 User Parameters

8.3.7 Module Installation and Un-installation

Refer to chapter 1 on "Module Insertion Mechanical keys" and "Module Insertion and Removable" for more details.

8.3.8 Technical Specification

LK612 16-Channel 48VDC Source DI module		
System Power Supply		
System Power Supply Voltage		24VDC(-15%~+20%)
System Power Consumption		50mA max@24VDC, exclusive of field power consumption
Input Channel		
Number of Channels		16
Contact Point Type		Dry contact, source input
Field Power Supply Rated Voltage		48VDC
Channel Closure Rated Voltage		5mA@48VDC
Threshold voltage Level(Vth)	ON	30VDC(2mA)~60VDC(7mA)
	OFF	10~10VDC(1.5mA)
Debounce filter time OFF→ON ON→OFF		Configuration options: 1ms, 3ms, 5ms, 10ms, 15ms, 20ms, 25ms, 30ms Configuration options: 1ms, 3ms, 5ms, 10ms, 15ms, 20ms, 25ms, 30ms
Reverse Protection		Maximum Voltage 100VDC
Isolation Voltage between Field and System		500VAC@1min, Current Leak 5mA
Failure Diagnosis and Hot Swap		
Field-side power loss diagnosis		Bit2 of the diagnosis byte (Bit0~Bit7) reported by the module provides the diagnosis information of field-side power supply. Bit2=1 indicates field power loss while Bit2=0 indicates field-side power loss recovered. Field power supply failure diagnosis is only reported once respectively when the failure occurs and when it is recovered.
Hot Swap		Support
Communication Bus		
Protocol		PROFIBUS-DP Slave Station, in accordance with IEC61258-3/EN50170 standards
Baud Rate		Baud Rate Options: 1.5Mbps, 500Kbps, 187.5Kbps, 93.75Kbps, 45.45Kbps, 31.25Kbps, 19.2Kbps, 9.6Kbps
Media		Communication bus is connected to the backplane through euro connector, hot redundant communication media
Physical Features		
Mechanic Keys to Prevent Incorrect Insertion		D1
Installation Location		LK local backplane or expansion backplane
Dimension		Width × Height × Depth = 35mm×100mm×100mm
Casing Protection Level		IEC60529 IP20
Weight		180g
Working Environment		
Working Temperature		0℃~60℃
Working Relative Humidity		5%~95%, no condensate
Storage Temperature		-40℃~70℃
Storage relative Humidity		5%~95%, no condensate

Table 8.12: Technical Specification of LK612 Module

8.4 LK613 16-CHANNEL 24VAC DI MODULE

8.4.1 Features

- 16 channels of contact point input
- Input voltage range: 14VAC~27VAC
- Support ProfiBus-DP Slave Station Protocol
- Field Power Loss Detection
- System-to-Field Isolation
- Supports hot swap

8.4.2 Operation Principles

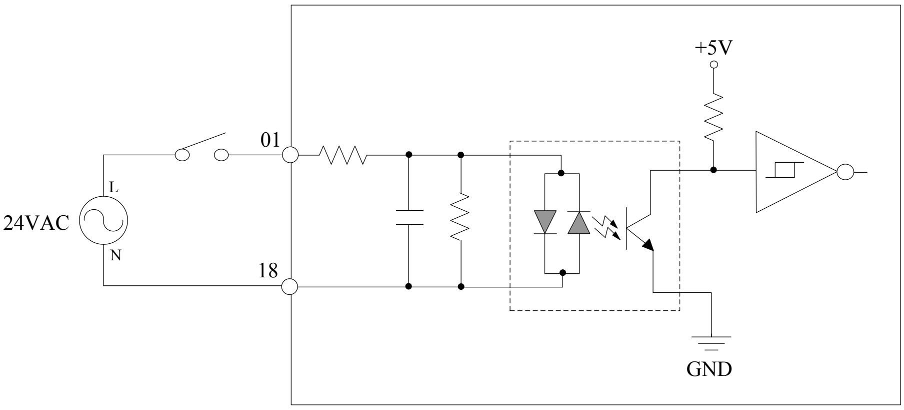


Figure 8.25: LK613 Channel Interface Circuit (Taking Channel1 as Example)

8.4.3 Indicators Definition

RUN indicator (Green)	On	Communication is established, module in normal operation
	Flash	Communication is not established or communication error
	Off	Power off of the module
Channel01~16 Indicators (Yellow)	On	Channel closed
	Off	Channel is disconnected

Table 8.13: Definition of LK613 Indicators

Specifications of RUN green light are as follows:

- After the power is on, the module waits for initialization data while the green light flashes with a frequency of 4 times per second.
- After the initialization is completed, the green light is constantly on to indicate the module in normal operation; if any error occurs in the initialization, then the communication is not established and the green light keeps flashing. Then, setting s of communication parameters (slave station address, etc) shall be checked.
- Green light is constantly on in normal communications; green light flashes when communication breaks; green light returns to constant on when communication re-established.

8.4.4 Wiring Specifications

Adopting 16 channels of dry contact points, LK613 needs a field power supply to drive its optical coupler.

LK613 module can be installed on either the LK local backplanes or the expansion backplanes. The LK series backplanes support two types of wrings: terminal wiring and prefabricated cable wring.

Wiring to Backplane Terminals

LK613 module is connected to field signals through the correspondence terminals under the local backplane installation slot. The relationship between each channel and terminal is shown in Figure 8.26. One ends of the 16 channel contacts connect to the wiring terminals (01~16) of the correspondence channels while the other ends all short connect to the L end of field power supply.

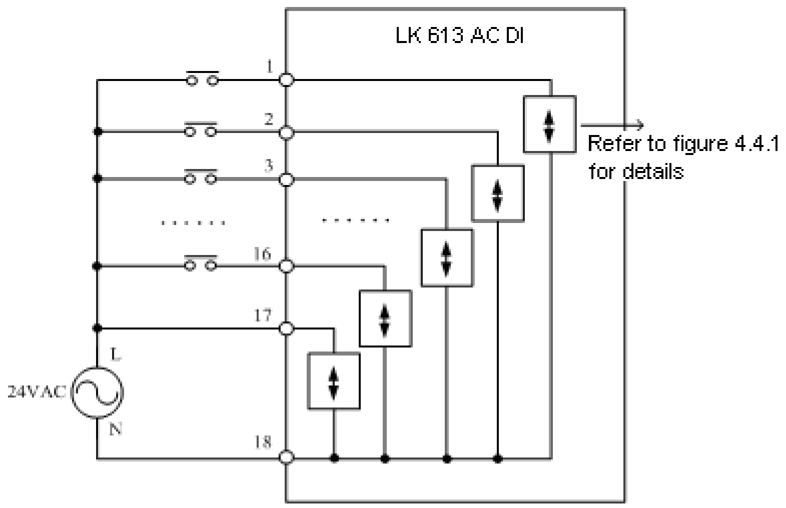


Figure 8.26: LK 613 Channel Interface of 16 Digital Inputs

Wiring of LK613 is connected through the terminals of its correspondence slot on the backplane. The relationship between channels and terminals is shown in Figure 8.27. In wiring, the following shall be noted:

- LK613 shall connect to an external 24VAC field power supply for its contacts. The field and the system are isolated.
- The 24VAC field power supply is shared by all 16 channels.
- Terminal "1~16" are the dry contact digital input ends of Channel 1~16.
- Terminal "17" can connect to the input end (the common end of all contacts) of field power supply for the field power loss detection.
- Terminal "18" connects to the return end of field power supply and is the module's internal common end of Channel 1~16.
- A single terminal shall not be connected to many wires; therefore multiple-point connection can be established through bus bar or transferring terminal board.

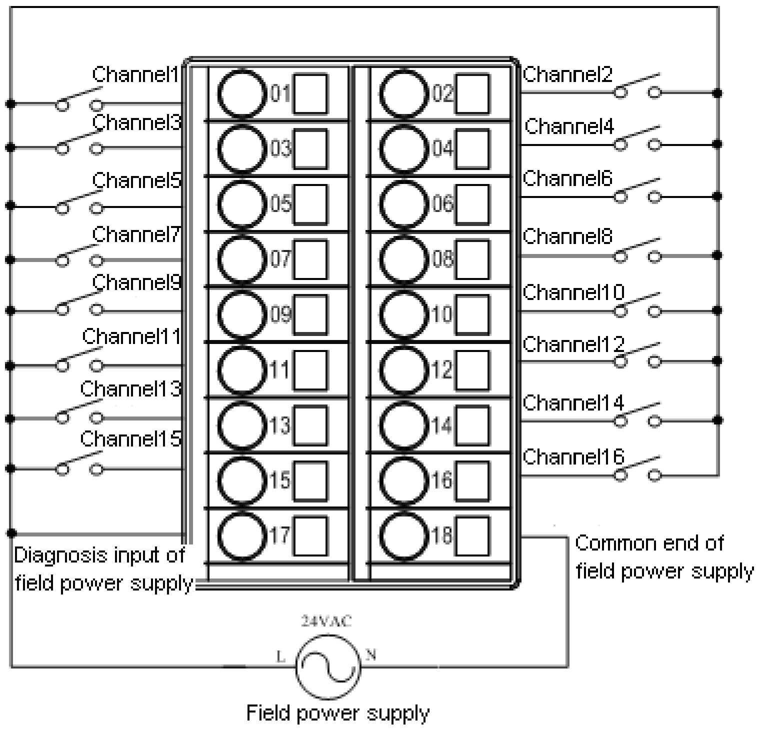


Figure 8.27: Wiring of LK613 Backplane Terminals

Wiring to Terminal Modules

Please refer to the information found on Chapter 12: Terminal Module.

8.4.5 Diagnosis Specifications of Diagnosis

PowerPro V4 configuration software adopts external diagnosis library to check and acquire all kinds of diagnosis information, such as whether the module and its channels are operating normally, whether the field power supplying smoothly and whether the module parameters are set correctly.

For the DP slave station modules, the DP slave station expansion diagnosis function block (HS_DPSlaveALarm) shall be called to check the DP module at any address (DP_Addr) on the PROFIBUS-DP link, as shown in Figure 8.28.

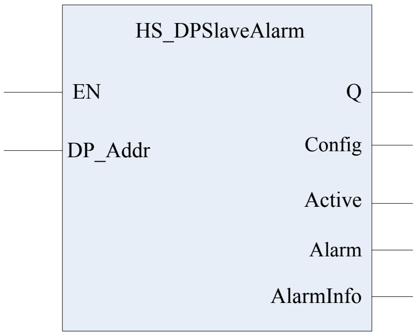


Figure 8.28: Expansion Diagnosis Function Block for DP Slave Station

For detailed usage of DP Expansion Diagnosis Function Block, please refer to LK Large Scale PLC Instruction Manual. Users shall note that the Diagnosis library is an external library that shall be first installed in the Library Manager before use.

The diagnosis information of DP slave station modules can be classified to 3 categories: device diagnosis, identifier diagnosis and channel diagnosis. All diagnosis data exist in the form of block structure.

Field Power Loss Detection

- LK613provides the field power loss detection. Whether to enable this function can be selected by user parameter "FieldPowerLossDetection", the default setting of which is "Enable". Modifications can only be effective after the full download.
- As shown in Figure 8.29, terminal "17" connects to the L end of field power supply while terminal "18" connects to its N end. LK613 carries out power loss detection by checking the changes of input voltage between these two terminals. In case of any failure, the failure status will be reported to the controller as the diagnosis data.
- When the field power supply voltage is in the range of 14~27VAC, the optical coupler switch of power loss detection channel is "ON" to indicate that field power supply is normal; when the field power supply voltage is lower than 5VAC, the optical coupler switch of power loss detection channel is "OFF" to indicate the field power loss; when the field power supply voltage is in the range of 5~14VAC, the status of the optical coupler switch is not determined.

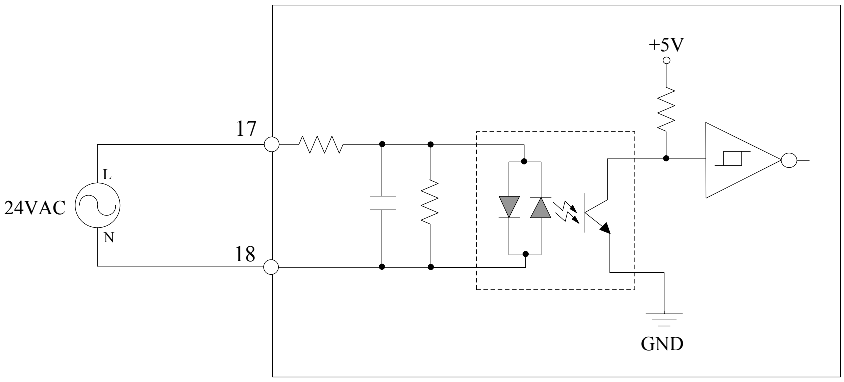


Figure 8.29: Field Power Loss Detection Circuit of LK613

- When the field 24VDC power supply is lost (line-break or power supply output voltage <5VAC), LK613 device diagnosis data area generates diagnosis byte "0x04" (Bit2 of this diagnosis byte =1), and reports this diagnosis byte to the controller in the next scan period.
- When the field 24VDC power supply is recovered (power supply output voltage in range 14~27VAC), LK613 device diagnosis data area generates a new diagnosis byte "0x00" (Bit2 of this diagnosis byte =0), and reports this diagnosis byte to the controller in the next scan period.

LK613 module will only report the diagnosis data once respectively when failure occurs and is recovered.

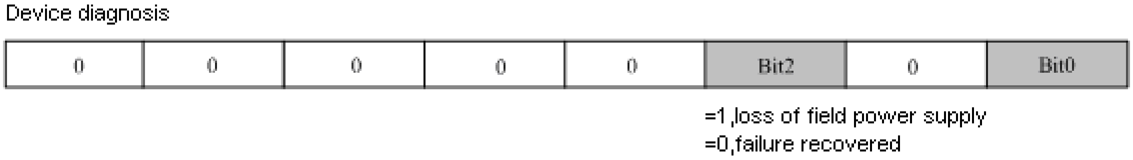


Figure 8.30: LK613 Diagnosis Byte

Field power loss detection is a kind of device diagnosis. The definition of its diagnosis byte is as shown in Figure 8.30. After the DP slave station expansion diagnosis function block is called, the diagnosis data reported by LK613 will be stored in the output field "DevDiag.Data.Data[1]" of the function block output parameter “AlarmInfo”, as shown in Table 8.14.

Device Diagnosis	Value	Definition
AlarmInfo.DevDiag.Data.Data[1]	0X04	Power Loss of Field Power Supply
	0x00	Failure recovered or no diagnosis data

Table 8.14: Definition of LK610 Diagnosis Information

8.4.6 Parameter Specifications

The controller can only read and write the I/O information regularly after it entered data exchange mode. Therefore, in order to provide correct parameter information in the initialization process, users shall first set the hardware parameters in the configuration software PowerPro V4.

Communication Parameters

Supporting PROFIBUS-DP slave station protocol, LK613 completes data exchanges and diagnosis information reporting with the controller and other DP master stations. The slave station adopts a unique communication address, which is determined by the backplane number and the slot number of the LK613 module. In configuration, the correct communication address of the module shall be written in the DP parameter. Normally, other parameters do not need any modification, as shown in Figure 8.31.

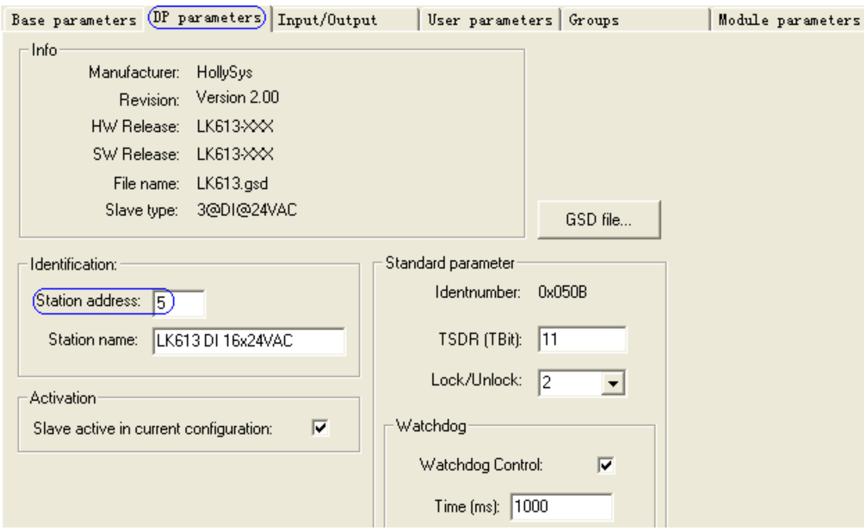


Figure 8.31: Setting of LK613 Communication Parameters

User Parameters

User parameters are used to configure the module's operating mode. They are written into the controller during the download of user program and will not be read in every scanning circle. Each parameter has a default value that can be changed according to requirements of the project. Modifications of parameter values can only be effective after the full download.

LK611 has totally 1 byte of user parameter, as shown in Table 8.15.

Parameter Name	Parameter Definition	Parameter Value
OFF to ON Filter Time	Input filter time in connection (OFF→ON)	0=9ms (Default) 1=18ms
ON to OFF Filter Time	Input filter time in disconnection (ON→OFF)	0=9ms (Default) 1=18ms
Field Power Loss Detection	Enable power loss detection	0=Disable, the function is disabled; 1=Enable, the function is enabled (default);

Table 8.15: Definition of LK613 User Parameters

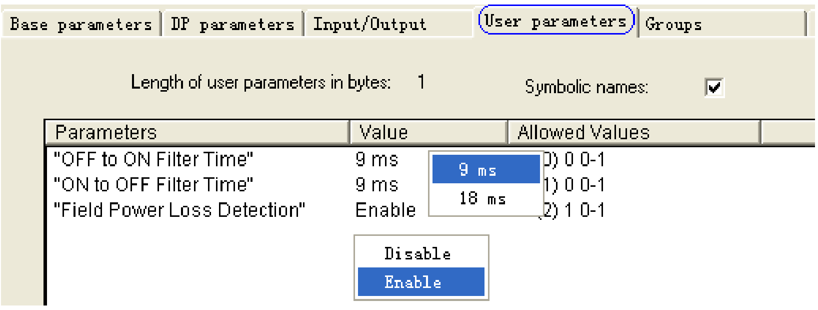


Figure 8.32: Setting of LK613 User Parameters

8.4.7 Module Installation and Un-installation

Refer to chapter 1 on "Module Insertion Mechanical keys" and "Module Insertion and Removable" for more details.

8.4.8 Technical Specification

LK613 16-Channel 24VAC DI module		
System Power Supply		
System Power Supply Voltage		24VDC(-15%~+20%)
System Power Consumption		50mA max@24VDC, exclusive of field power consumption
Input Channel		
Number of Channels		16
Contact Point Type		Dry contact
Field Power Supply Rated Voltage		24V AC
Channel Closure Rated Voltage		5.5mA@24VAC
Threshold voltage Level(Vth)	ON	14VAC(3mA)~27VAC(6.2mA), 47~63Hz
	OFF	0~5VAC (1.5mA)
Debounce filter time OFF→ON ON→OFF		Configurable Filter: options of 9ms, 18ms, hardware delay 10ms max. Configurable Filter: options of 9ms, 18ms, hardware delay 10ms max.
Isolation Voltage between Field and System		500VAC@1min, Current Leak 5mA
Failure Diagnosis and Hot Swap		
Field-side power loss diagnosis		Bit2 of the diagnosis byte (Bit0~Bit7) reported by the module provides the diagnosis information of field power supply. Bit2=1 indicates field power loss while Bit2=0 indicates field-side power loss recovered. Field power supply failure diagnosis is only reported once respectively when the failure occurs and when it is recovered.
Hot Swap		Support
Communication Bus		
Protocol		PROFIBUS-DP Slave Station, in accordance with IEC61358-3/EN50170 standards
Baud Rate		Baud Rate Options: 1.5Mbps, 500Kbps, 187.5Kbps, 93.75Kbps, 45.45Kbps, 31.25Kbps, 19.2Kbps, 9.6Kbps
Media		Communication bus is connected to the backplane through euro connector, hot redundant communication media
Physical Features		
Mechanic Keys to Prevent Incorrect Insertion		D2
Installation Location		LK local backplane or expansion backplane
Dimension		Width × Height × Depth = 35mm×100mm×100mm
Casing Protection Level		IEC60529 IP20
Weight		180g
Working Environment		
Working Temperature		0℃~60℃
Working Relative Humidity		5%~95%, no condensate
Storage Temperature		-40℃~70℃
Storage relative Humidity		5%~95%, no condensate

Table 8.16: Technical Specification of LK613 Module

8.5 LK614 16-CHANNEL 120VAC DI MODULE

8.5.1 Features

- 16 channels of contact point input
- Input voltage range: 74VAC~132VAC
- Support ProfiBus-DP Slave Station Protocol
- Field Power Loss Detection
- System-to-Field Isolation
- Supports hot swap

8.5.2 Operation Principles

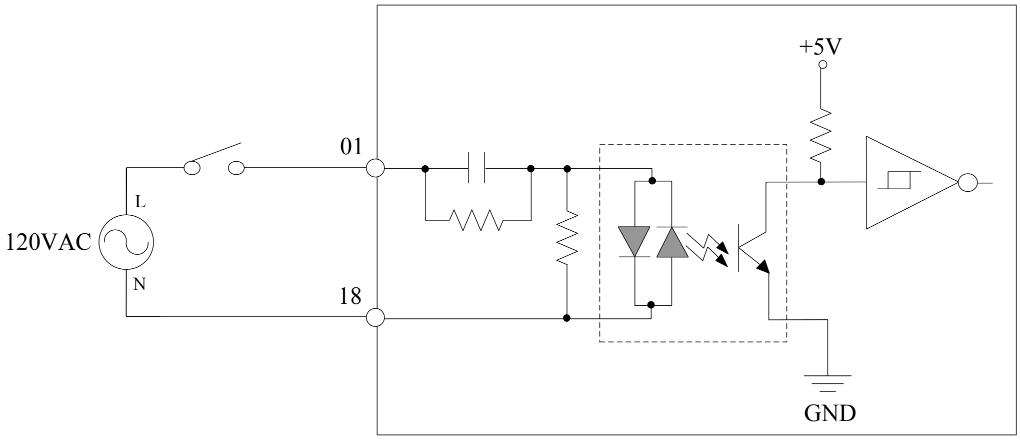


Figure 8.33: LK614 Channel Interface Circuit (Taking Channel1 as Example)

8.5.3 Indicator Definition

RUN indicator (Green)	On	Communication is established, module in normal operation
	Flash	Communication is not established or communication error
	Off	Power off of the module
Channel01~16 Indicators (Yellow)	On	The channel is connected
	Off	Channel is disconnected

Table 8.17: Definition of LK614 Indicators

Specifications of RUN green light are as follows:

- After the power is on, the module waits for initialization data while the green light flashes with a frequency of 4 times per second.
- After the initialization is completed, the green light is constantly on to indicate the module in normal operation; if any error occurs in the initialization, then the communication is not established and the green light keeps flashing. Then, communication parameter settings shall be checked.
- Green light is constantly on in normal communications; green light flashes when communication breaks; green light returns to constant on when communication re-established.

8.5.4 Wiring Specifications

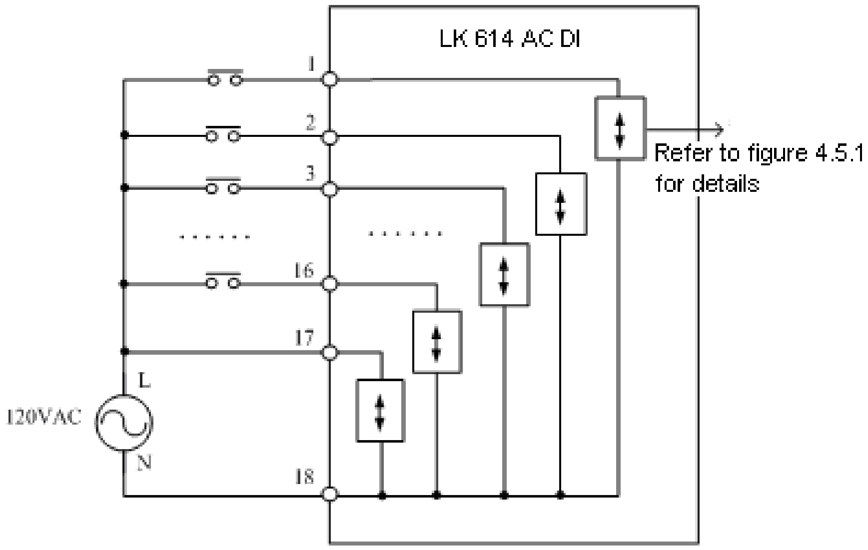


Figure 8.34: LK 614 Channel Interface of 16 Digital Inputs

Adopting 16 channels of dry contact points, LK614 needs a field power supply to drive its optical coupler.

LK614 module can be installed on either the LK local backplanes or the expansion backplanes. The LK series backplanes support two types of wrings: terminal wiring and prefabricated cable wring.

Wiring to Backplane Terminals

LK614 module is connected to field signals through the correspondence terminals under the local backplane installation slot. The relationship between each channel and terminal is shown in Figure 8.35. One ends of the 16 channel contacts connect to the wiring terminals (01~16) of the correspondence channels while the other ends all short connect to the L end of field power supply.

In the wiring, the following shall be noted:

- LK614 shall connect to an external 24VAC field power supply for its contacts and to ensure the isolation between the field and the system.
- The 120VAC field power supply is shared by all 16 channels.
- Terminal "1~16" are the dry contact digital input ends of Channel 1~16.
- Connect through live line to the input ends (the common end of each contact point) of field power supply, Terminal "17" provides the diagnosis input of field power supply for the field power loss detection.
- Terminal "18" connects to the return end of field power supply through ground line and is the module's internal common end of Channel 1~16.
- A single terminal shall not be connected to many wires; therefore multiple-point connection can be established through bus bar or transferring terminal board.

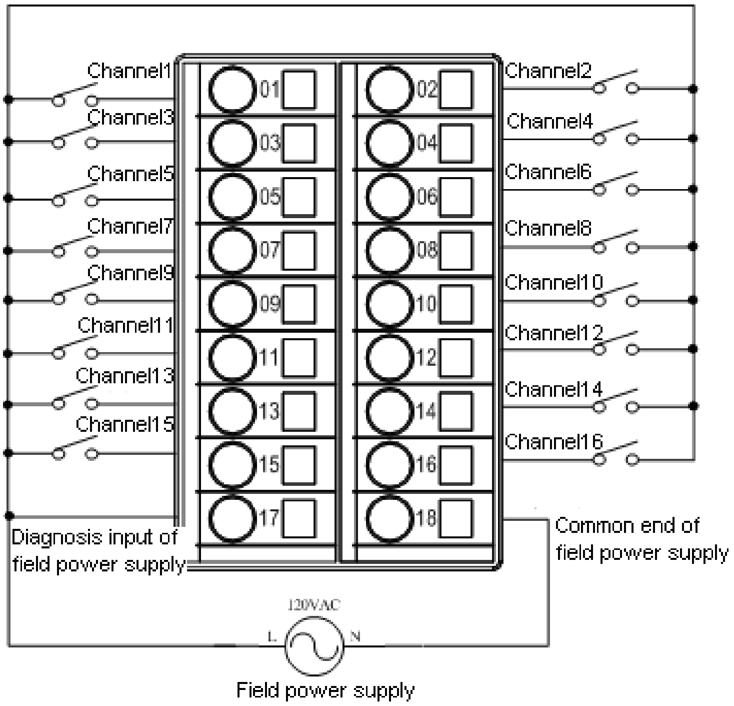


Figure 8.35: Wiring of LK614 Backplane Terminals

Wiring to Terminal Modules

Please refer to the information found on Chapter 12: Terminal Module.

8.5.5 Diagnosis Specifications

PowerPro V4 configuration software adopts external diagnosis library to check and acquire all kinds of diagnosis information, such as whether the module and its channels are operating normally, whether the field power supplying smoothly and whether the module parameters are set correctly.

For the DP slave station modules, the DP slave station expansion diagnosis function block (HS_DPSlaveALarm) shall be called to check the DP module at any address (DP_Addr) on the PROFIBUS-DP link, as shown in Figure 8.36.

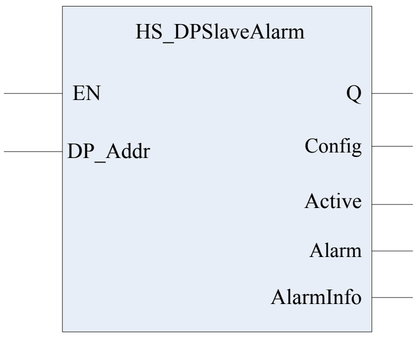


Figure 8.36: Expansion Diagnosis Function Block for DP Slave Station

For detailed usage of DP Expansion Diagnosis Function Block, please refer to LK Large Scale PLC Instruction Manual. Users shall note that the Diagnosis library is an external library that shall be first installed in the Library Manager before use.

The diagnosis information of DP slave station modules can be classified to 3 categories: device diagnosis, identifier diagnosis and channel diagnosis. All diagnosis data exist in the form of block structure.

Field Power Loss Detection

- LK614 provides the field power loss detection. Whether to enable this function can be selected by user parameter "FieldPowerLossDetection", the default setting of which is "Enable". Modifications can only be effective after the full download.

- As shown in Figure 8.37, terminal "17" connects to the L end of field power supply while terminal "18" connects to its N end. LK614 carries out power loss detection by checking the changes of input voltage between these two terminals. In case of any failure, the failure status will be reported to the controller as the diagnosis data.
- When the field power supply voltage is in the range of 74~132VAC, the optical coupler switch of power loss detection channel is "ON" to indicate that field power supply is normal; when the field power supply voltage is in the range of 0~20VAC, the optical coupler switch of power loss detection channel is "OFF" to indicate the field power loss; when the field power supply voltage is in the range of 20~74VAC, the status of the optical coupler switch is not determined.

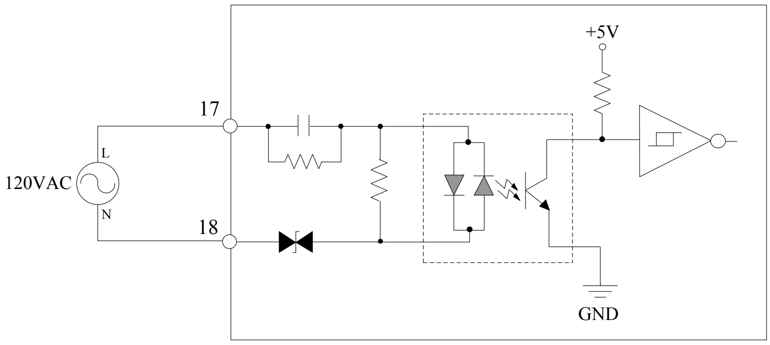


Figure 8.37: Field Power Loss Detection Circuit of LK614

- When the field 120VAC power supply is lost (line-break or power supply output voltage <20VAC), LK614 device diagnosis data area generates diagnosis byte "0x04" (Bit2 of this diagnosis byte =1), and reports this diagnosis byte to the controller in the next scan period.
- When the field 120VAC power supply is recovered (power supply output voltage in range 74~132VAC), LK614 device diagnosis data area generates a new diagnosis byte "0x00" (Bit2 of this diagnosis byte =0), and reports this diagnosis byte to the controller in the next scan period.

LK614 module will only report the diagnosis data once respectively when failure occurs and is recovered.

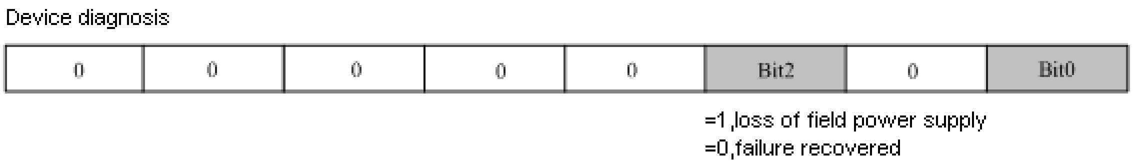


Figure 8.38: LK614 Diagnosis Byte

Field power loss detection is a kind of device diagnosis. The definition of its diagnosis byte is as shown in Figure 8.38. After the DP slave station expansion diagnosis function block is called, the diagnosis data reported by LK611 will be stored in the output field "DevDiag.Data.Data[1]" of the function block output parameter "AlarmInfo", as shown in Table 8.18.

Device Diagnosis	Value	Definition
ALarmInfo.DevDiag.Data.Data[1]	0X04	Power Loss of Field Power Supply
	0x00	Failure recovered or no diagnosis data

Table 8.18: Definition of LK614 Diagnosis Information

8.5.6 Parameter Specifications

The controller can only read and write the I/O information regularly after it entered data exchange mode. Therefore, in order to provide correct parameter information in the initialization process, users shall first set the hardware parameters in the configuration software PowerPro V4.

Communication Parameters

Supporting PROFIBUS-DP slave station protocol, LK614 completes data exchanges and diagnosis information reporting with the controller and other DP master stations. The slave station adopts a unique communication address, which is determined by the backplane number and the slot number of the LK614 module. In configuration, the correct communication address of the module shall be written in the DP parameter. Normally, other parameters do not need any modification, as shown in Figure 8.39.

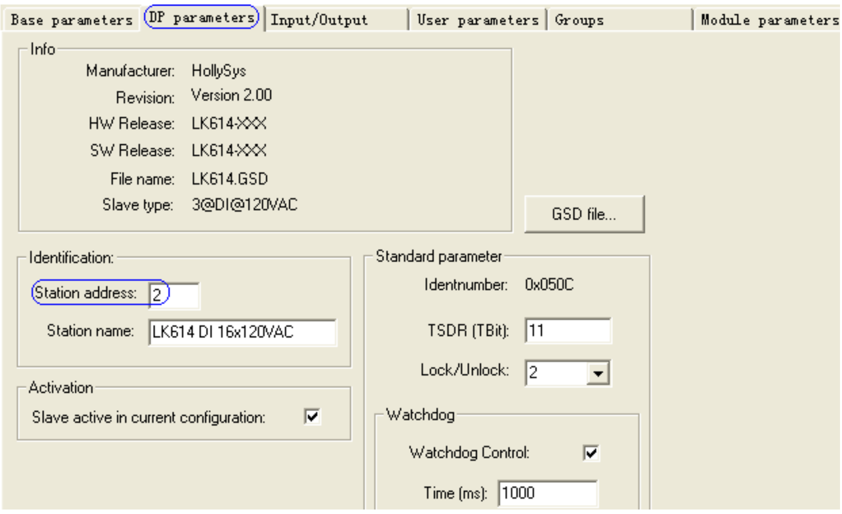


Figure 8.39: Setting of LK614 Communication Parameters

User Parameters

User parameters are used to configure the module’s operating mode. They are written into the controller during the download of user program and will not be read in every scanning circle. Each parameter has a default value that can be changed according to requirements of the project. Modifications of parameter values can only be effective after the full download.

LK614 has totally 1 byte of user parameters, as shown in Table 8.19.

Parameter Name	Parameter Definition	Parameter Value
OFF to ON Filter Time	Input filter time in connection (OFF→ON)	0=9ms (Default) 1=18ms
ON to OFF Filter Time	Input filter time in disconnection (ON→OFF)	0=9ms (Default) 1=18ms
Field Power Loss Detection	Enable power loss detection	0=Disable, the function is disabled; 1=Enable, the function is enabled (default);

Table 8.19: Definition of LK614 User Parameters

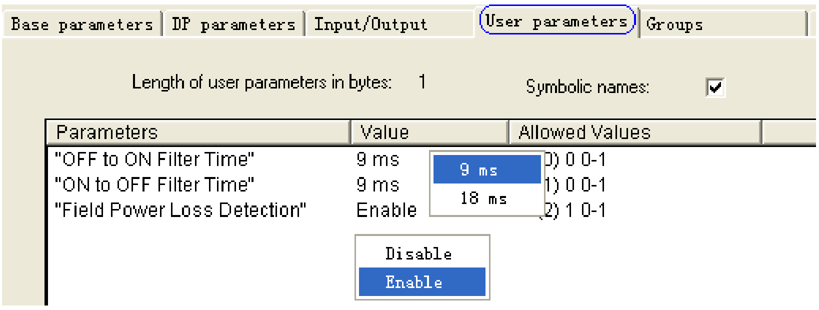


Figure 8.40: Setting of LK614 User Parameters

8.5.7 Module Installation and Un-installation

Refer to chapter 1 on “Module Insertion Mechanical keys” and “Module Insertion and Removable” for more details.

8.5.8 Technical Specification

LK614 16-Channel 120VAC DI module		
System Power Supply		
System Power Supply Voltage		24VDC(-15%~+20%)
System Power Consumption		45mA max@24VDC, exclusive of field power consumption
Input Channel		
Number of Channels		16
Contact Point Type		Dry contact
Field Power Supply Rated Voltage		120V AC
Channel Closure Rated Voltage		5.5mA@120VAC
Threshold voltage Level(Vth)	ON	74VAC(2.8mA)~132VAC(5.4mA)@47~63Hz
	OFF	0~20VAC
Debounce filter time OFF→ON ON→OFF		Software filter: 9ms, 18ms configurable; hardware delay: 4ms~15ms Software filter: 9ms, 18ms configurable; maximum hardware delay: 5ms
Isolation Voltage between Field and System		850VAC@1min, Current Leak 5mA
Failure Diagnosis and Hot Swap		
Field-side power loss diagnosis		Bit2 of the diagnosis byte (Bit0~Bit7) reported by the module provides the diagnosis information of field-side power supply. Bit2=1 indicates field power loss while Bit2=0 indicates field-side power loss recovered. Field power supply failure diagnosis is only reported once respectively when the failure occurs and when it is recovered.
Hot Swap		Support
Communication Bus		
Protocol		PROFIBUS-DP Slave Station, in accordance with IEC61158-3/EN50170 standards
Baud Rate		Baud Rate Options: 1.5Mbps, 500Kbps, 187.5Kbps, 93.75Kbps, 45.45Kbps, 31.25Kbps, 19.2Kbps, 9.6Kbps
Media		Communication bus is connected to the backplane through euro connector, hot redundant communication media
Physical Features		
Mechanic Keys to Prevent Incorrect Insertion		A3
Installation		LK local backplane or expansion backplane
Dimension		Width × Height × Depth = 35mm×100mm×100mm
Casing Protection Level		IEC60529 IP20
Weight		180g
Working Environment		
Working Temperature		0℃~60℃
Working relative Humidity		5%~95%, no condensate
Storage Temperature		-40℃~70℃
Storage relative Humidity		5%~95%, no condensate

Table 8.20: Technical Specification of LK614 Module

8.6 LK615 16-CHANNEL 230VAC DI MODULE

8.6.1 Features

- 16 channels of dry contact point input
- Field power supply voltage range: 159VAC~265VAC
- Support ProfiBus-DP Slave Station Protocol
- Field Power Loss Detection
- System-to-Field Isolation
- Supports hot swap

8.6.2 Operation Principles

Threshold Level of LK615:

- Logic 1: voltage range 159~265VAC, Current 1.5mA (159VAC) ~ 2.5mA (265VAC)
- Logic 0: maximum voltage 40VAC, maximum current 0.5mA

As shown in Figure 8.41, when input voltage is in the range of 159~265VAC, the Light Emitting Diode (LED) side of the optical coupler is connected and the trigger outputs a high voltage level; when input voltage is lower than or equals to 40VAC or the input current is smaller than or equals to 0.5mA, the LED side of the optical coupler is disconnected and the trigger outputs a low voltage level.

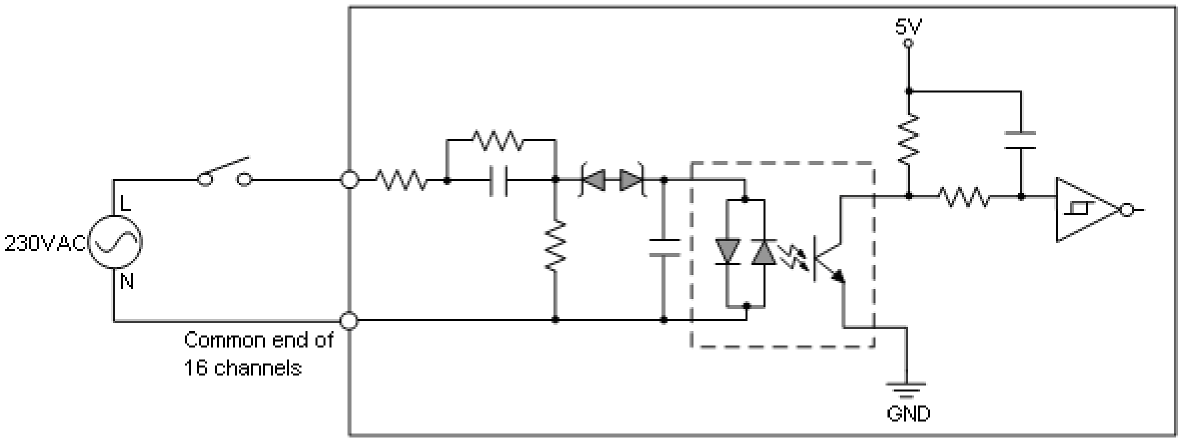


Figure 8.41: LK615 Channel Interface Circuit

8.6.3 Indicators Definition

RUN indicator (Green)	On	Communication is established, module in normal operation
	Flash	Communication is not established or communication error
	Off	Power Off or Module Failure
Channel01~16 Indicators (Yellow)	On	The channel is connected
	Off	Channel is disconnected

Table 8.21: Definition of LK615 Indicators

Specifications of RUN green light are as follows:

- After the power is on, the module waits for initialization data while the green light flashes with a frequency of 4 times per second.
- After the initialization is completed, the green light is constantly on to indicate the module in normal operation; if any error occurs in the initialization, then the communication is not established and the green light keeps flashing. Then, setting s of communication parameters (slave station address, etc) shall be checked.
- Green light is constantly on in normal communications; green light flashes when communication breaks; green light returns to constant on when communication re-established.

8.6.4 Wiring Specifications

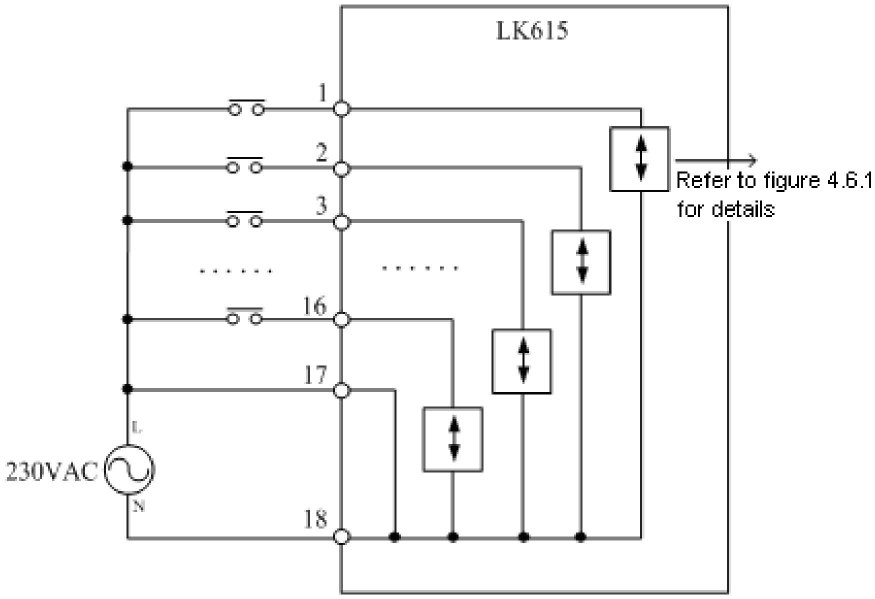


Figure 8.42: LK 615 Channel Interface of 16 Digital Inputs

LK615 module needs field power supply for its DI contacts and to drive its optical coupler. To ensure the isolation between field and system, this 230VAC field-side power supply shall be separated from the backplane power supply.

LK615 module is installed on LK series backplanes that support two types of wirings: terminal wiring and prefabricated cable wring.

Wiring to Backplane Terminals

LK615 module is connected to field signals through the correspondence terminals under the local backplane installation slot. The relationship between each channel and terminal is shown in Figure 8.43. One ends of the 16 channel contacts connect to the wiring terminals (01~16) of the correspondence channels while the other ends all short connect to the L end of field power supply.

In the wiring, the following shall be noted:

- Connect to separate external 230VAC field power supply.
- Terminal "1~16" are the contact digital input ends of Channel 1~16.
- Terminal "17" connects to the input end of field power supply (normally through live line) for the field power loss detection.
- Terminal "18" connects to the return end of field power supply through ground line and is the module's internal common end of Channel 1~16.
- A single terminal shall not be connected to many wires; therefore multiple-point connection can be established through bus bar or transferring terminal board.

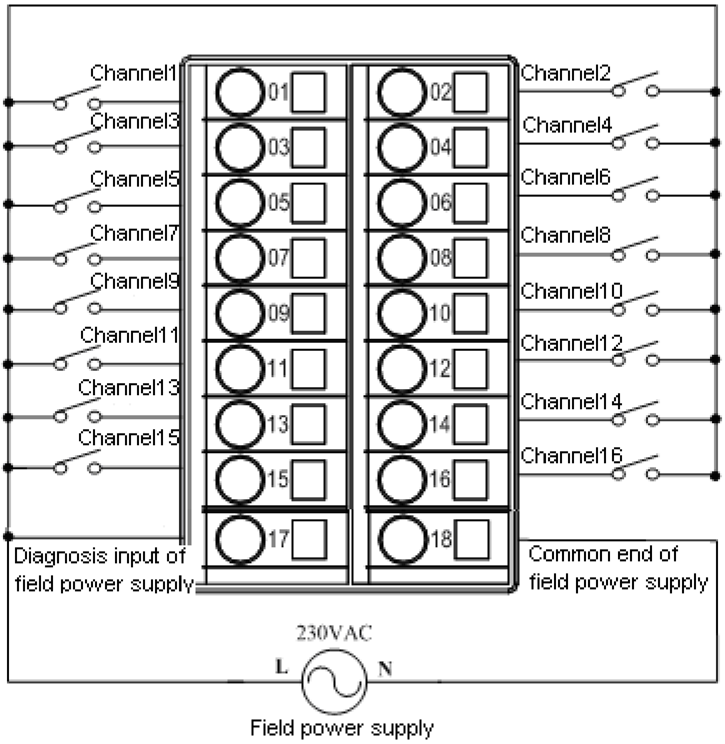


Figure 8.43: Wiring of LK615 Backplane Terminals

Wiring to Terminal Modules

Please refer to the information found on Chapter 12: Terminal Module.

8.6.5 Specifications of Diagnosis

PowerPro V4 configuration software adopts external diagnosis library to check and acquire all kinds of diagnosis information, such as whether the module and its channels are operating normally, whether the field power supplying smoothly and whether the module parameters are set correctly.

For the DP slave station modules, the DP slave station expansion diagnosis function block (HS_DPSlaveALarm) shall be called to check the DP module at any address on the PROFIBUS-DP link, as shown in Figure 8.44.

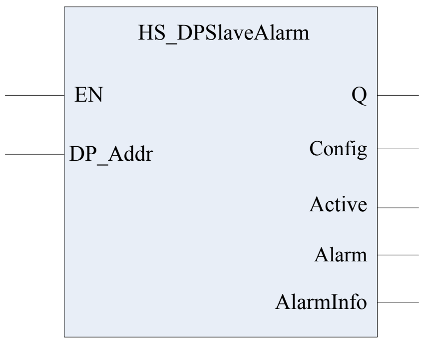


Figure 8.44: Expansion Diagnosis Function Block for DP Slave Station

For detailed usage of DP Expansion Diagnosis Function Block, please refer to LK Large Scale PLC Instruction Manual. Users shall note that the Diagnosis library is an external library that shall be first installed in the Library Manager before use.

The diagnosis information of DP slave station modules can be classified to 3 categories: device diagnosis, identifier diagnosis and channel diagnosis. All diagnosis data exist in the form of block structure.

Field Power Loss Detection

- LK615 provides the field power loss detection. Whether to enable this function can be selected by user parameter “FieldPowerLossDetection”, the default setting of which is “Enable”. Modifications can only be effective after the full download.

- Terminal "17" connects to the L end of field power supply while terminal "18" connects to its N end. LK615 carries out power loss detection by checking the changes of input voltage between these two terminals. In case of any failure, the failure status will be reported to the controller as the diagnosis data.
- When the field 230VAC power supply is lost (line-break or power supply output voltage <40VAC), LK615 device diagnosis data area generates diagnosis byte "0x04" (Bit2 of this diagnosis byte =1), and reports this diagnosis byte to the controller in the next scan period.
- When the field 230VAC power supply is recovered (power supply output voltage in range 159~265VAC), LK615 device diagnosis data area generates a new diagnosis byte "0x00" (Bit2 of this diagnosis byte =0), and reports this diagnosis byte to the controller in the next scan period.
- LK615 module will only report the diagnosis data once respectively when failure occurs and is recovered.

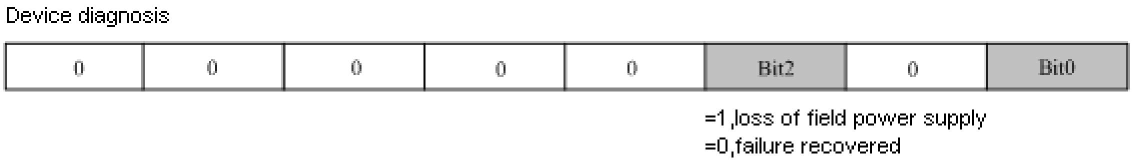


Figure 8.45: LK615 Diagnosis Byte

Field power loss detection is a kind of device diagnosis. The definition of its diagnosis byte is as shown in Figure 8.45. After the DP slave station expansion diagnosis function block is called, the diagnosis data reported by LK615 will be stored in the output field "DevDiag.Data.Data[1]" of the function block output parameter "AlarmInfo", as shown in Table 8.22.

Device Diagnosis	Value	Definition
ALarmInfo.DevDiag.Data.Data[1]	0X04	Power Loss of Field Power Supply
	0x00	Failure recovered or no diagnosis data

Table 8.22: Definition of LK615 Diagnosis Information

8.6.6 Parameter Specifications

The controller can only read and write the I/O information regularly after it entered data exchange mode. Therefore, in order to provide correct parameter information in the initialization process, users shall first set the hardware parameters in the configuration software PowerPro V4.

As shown in Figure 8.46, after adding "LK615 DI 16x230VAC" in the PROFIBUS-DP link, user can configure the hardware parameters of LK615. The hardware parameters can be configured with LK615 module includes communication parameter and user parameters. The specifications of each are as follows:

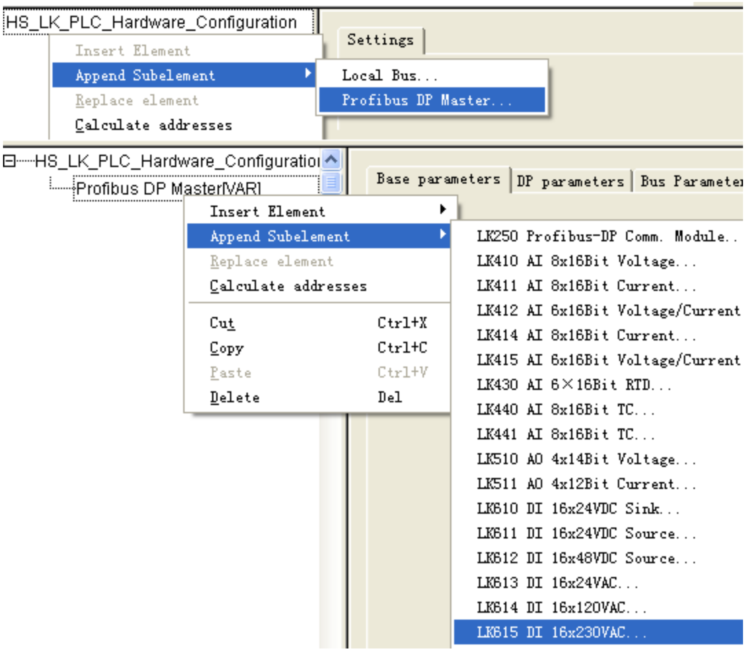


Figure 8.46: Add LK615 in PowerPro V4 Configuration Software

Communication Parameters

- Communication address is the DP module node number for the communication with the controller. In the PROFIBUS-DP bus link, a unique communication address is assigned to each module. If there is any error of the communication address, the slave station module will not be able to establish communication with the controller.
- Installed on the LK backplane, the unique communication address of LK615 module is determined only by its installation location. *Refer to Chapter 2: Backplanes for the details of communication address assignment.*
- After a DP module is added, it will have a default "station address", as shown in Figure 8.47. This address is not the correct communication address of the module but an address automatically assigned to the module by the software according to the adding order.
- The correct communication address of each DP module shall be re-assigned in parameter "station address". Other parameters keep their default value and do not need modification.
- If modules have been added or deleted in the configuration software, or the slot number of module on the backplane has been changed, the communication address in "station address" shall be check to ensure the accuracy.

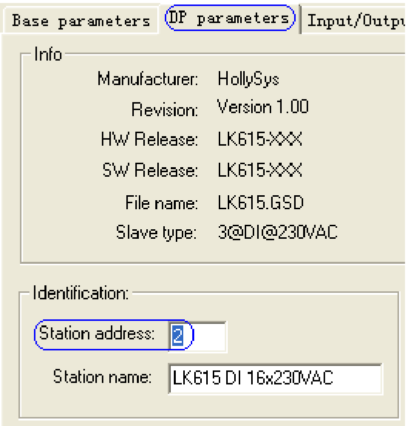


Figure 8.47: Setting of LK615 Communication Address

User Parameters

- User parameters are used to configure the module's operating mode. They are written into the controller during the download of user program and will not be read in every scanning circle. Each parameter has a default value that can be changed according to requirements of the project. Modifications of parameter values can only be effective after the full download.
- User parameters of LK615 include software filter time selection and that to enable field power loss detection. The definition of parameters is shown in Table 8.23.

User Parameters	Parameter Definition
OFF to ON Filter Time	OFF→ON (rising edge) software filter time =0, 9ms (Default) =1, 18ms
ON to OFF Filter Time	ON→OFF (falling edge) software filter time =0, 9ms (Default) =1, 18ms
Field Power Loss Detection	Enable Field Power Supply Loss Detection =0, Disable, the function is disabled; =1, Enable, the function is enabled (default);

Table 8.23: Definition of LK615 User Parameters

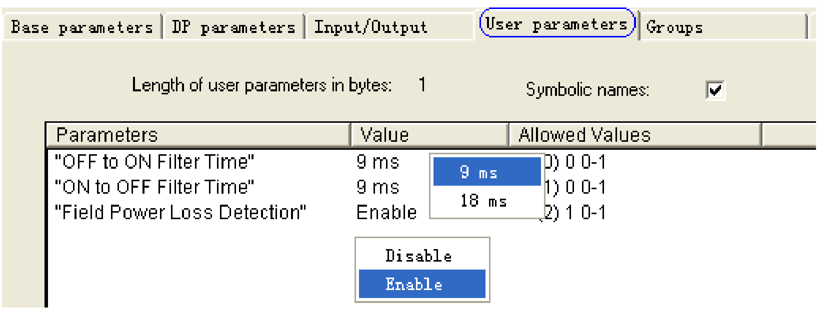


Figure 8.48: LK615 User Parameter Interface

8.6.7 Module Installation and Un-installation

Refer to chapter I on "Module Insertion Mechanical keys" and "Module Insertion and Removable" for more details.

8.6.8 Technical Specification

LK615 16-Channel 230VAC DI module		
System Power Supply		
System Power Supply Voltage		24VDC(-15%~+20%)
System Power Consumption		50mA max@24VDC, exclusive of field power consumption
Input Channel		
Number of Channels		16
Field Power Supply Rated Voltage		230V AC
Threshold voltage Level(Vth)	ON	159(1.5mA)~265VAC(2.5mA)@47~63Hz
	OFF	0~40VAC (0.5mA) @47~63Hz
Debounce filter time OFF→ON ON→OFF		Software filter: 9ms, 18ms configurable; hardware delay: 15ms max. Software filter: 9ms, 18ms configurable; hardware delay: 10ms max.
Isolation Voltage between Field and System		1000VAC@1min, Current Leak 5mA
Failure Diagnosis and Hot Swap		
Field-side power loss diagnosis		Bit2 of the diagnosis byte (Bit0~Bit7) reported by the module provides the diagnosis information of field-side power supply. Bit2=1 indicates field power loss while Bit2=0 indicates field-side power loss recovered. Field power supply failure diagnosis is only reported once respectively when the failure occurs and when it is recovered.
Hot Swap		Support
Communication Bus		
Protocol		PROFIBUS-DP Slave Station, in accordance with IEC61158-3/EN50170 standards
Baud Rate		Baud Rate Options: 1.5Mbps, 500Kbps, 187.5Kbps, 93.75Kbps, 45.45Kbps, 31.25Kbps, 19.2Kbps, 9.6Kbps
Media		Communication bus is connected to the backplane through euro connector, hot redundant communication media
Physical Features		
Mechanic Keys to Prevent Incorrect Insertion		A4
Installation		Installation slot
Dimension		Width × Height × Depth = 35mm×100mm×100mm
Casing Protection Level		IEC60529 IP20
Weight		180g
Working Environment		
Working temperature		0℃~60℃
Working Relative Humidity		5%~95%, no condensate
Storage Temperature		-40℃~70℃
Storage Relative Humidity		5%~95%, no condensate

Table 8.24: Technical Specification of LK615 Module

Chapter 9

CHAPTER 9: DIGITAL OUTPUT MODULES

9.1 LK710 16-CHANNEL 24VDC SOURCE DO MODULE

9.1.1 Features

- 16 channels of MOSFET source outputs
- Output voltage range: 10VDC~31.2VDC
- Support ProfiBus-DP Slave Station Protocol
- Fault Mode Output
- Program mode output
- Output readback diagnosis
- Field Power Loss Detection
- Over-Current Protection
- System-to-Field Isolation
- Supports hot swap

9.1.2 Operation Principles

As shown in Figure 9.1, one end of the load connects to the negative end of field power supply while its other end connects to LK710 module. When the MOSFET electronic switch is closed, current comes out of the switch to supply power for the load while the 16 channels of switches share power supply inside the module.

The controller writes output data and scheduled time into the data memory of LK710 through high-speed bus. The output data control the MOSFET electronic switch to output commands of close or open. When the control signal is a high electric level, the optical coupler diode side is connected and the electronic switch is closed to drive the load and to achieve the digital output.

The diode has the function to continue the current. When the external load is inductive, it becomes the induced current release channel after the power surge.

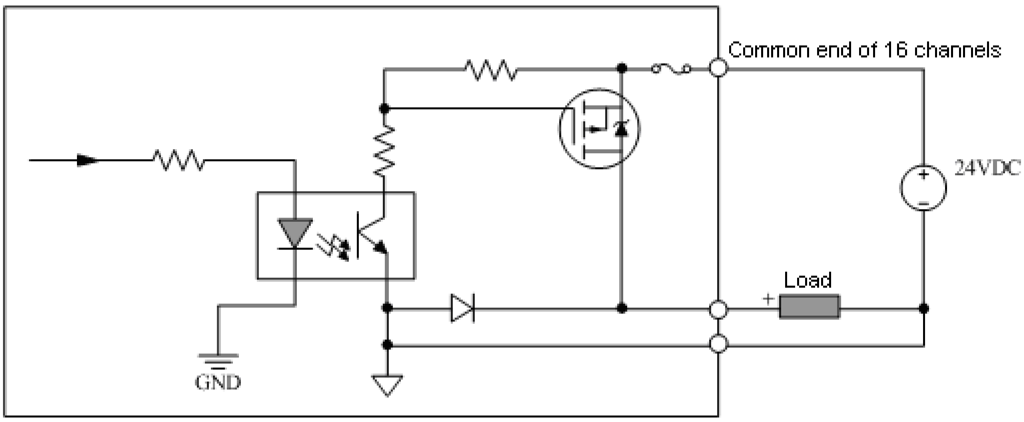


Figure 9.1: LK710 Channel Interface Circuit

9.1.3 Indicators Definition

RUN indicator (Green)	On	Communication is established, module in normal operation
	Flash	Communication is not established or communication error
	Off	Power off of the module
Channel01~16 Indicators (Yellow)	On	The channel is closed
	Off	The channel is opened

Table 9.1: Definition of LK710 Indicators

Specifications of RUN green light are as follows:

- After the power is on, the module waits for initialization data while the green light flashes with a frequency of 4 times/second.
- After the initialization is completed, the green light is constantly on to indicate the module in normal operation; if any error occurs in the initialization, then the communication is not established and the green light keeps flashing. Then, communication parameter settings shall be checked.
- In normal communication, the green light is constantly on; when communication halts, the green light flashes and the module enters fault mode automatically to output the fault mode state; when the communication is re-established, the green light is constantly on again and the module automatically exits fault mode.
- Wiring Specifications
- The contact type of LK719 output is dry contact point, hence the module needs a field power supply to drive the output of the electronic switch. The field power supply can be a 5~125VDC power or a 10~265VAC power, which can be selected according to different types of the load.
- LK710 module is installed on LK series backplanes that support two types of wirings: terminal wiring and prefabricated cable wring.

9.1.4 Wiring Specification

Wiring to Backplane Terminals

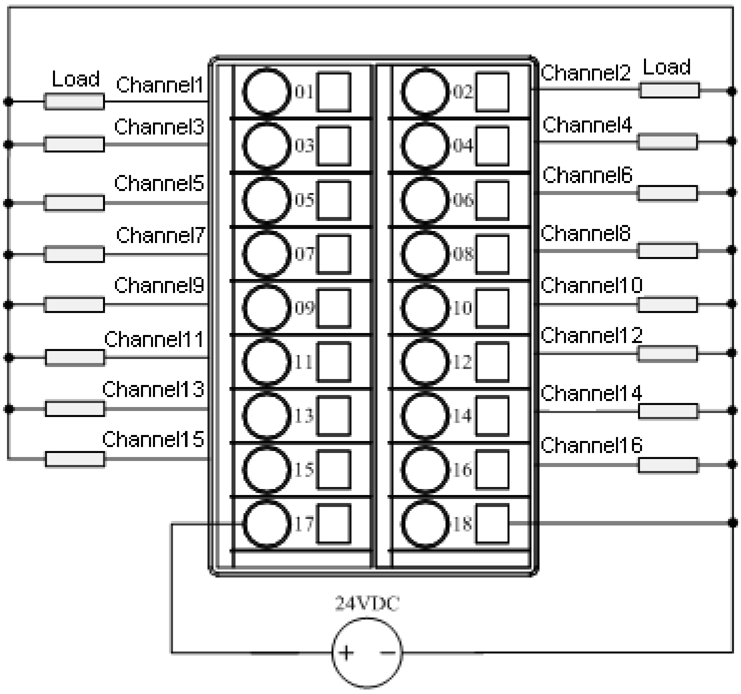


Figure 9.2: Wiring of LK710 Backplane Terminals

In the wiring, the following shall be noted:

- The module does not provide reverse voltage protection. Therefore, if there is any error in the wiring, the internal circuit can get burnt.
- To ensure the isolation between field and system, the field-side power supply shall be separated from the system power supply on the backplane.
- A 24VDC field power supply is shared by all 16 channels.
- Terminal "1~16" are the transistor digital outputs ends of Channel 1~16.
- Terminal "17" is the input positive end of the field power supply shared by the 16 channels of DO signals.
- Terminal "18" connects to the negative end of field power supply for the field power loss detection.
- A single terminal shall not be connected to many wires; therefore multiple-point connection can be established through bus bar or transferring terminal board.

Wiring to Terminal Modules

Please refer to the information found on Chapter 12: Terminal Module.

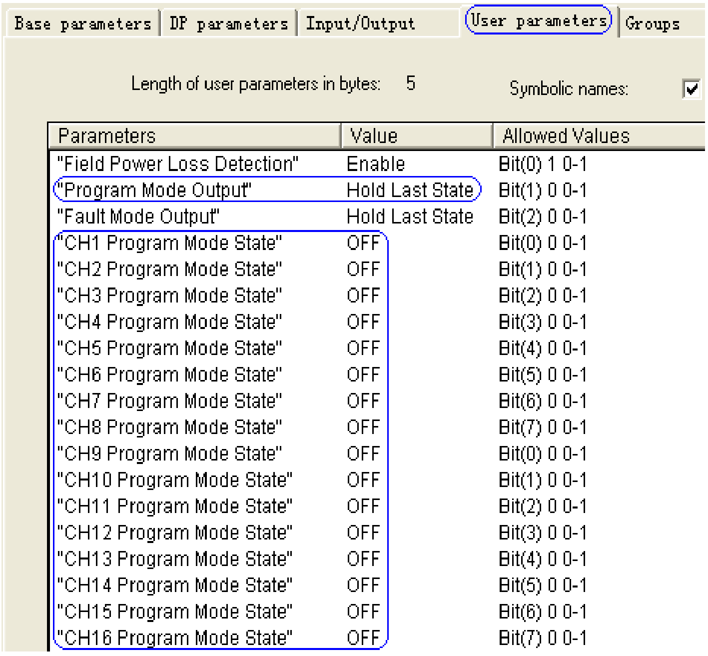
9.1.5 Function Specifications

Enable Output

- After the output module is power on, if it does not receive any output command from the controller, it will keep the initial mode and does no output. The output of an initial mode module is disabled. In this case, the module will keep this initial mode even it enters program mode or fault mode.
- After the operation of user programs, the controller sends output command to the output module through PROFIBUS-DP bus. Output module receives command and outputs data. The output of a slave module is enabled once the module outputs a command sent by the controller. When the module output is enabled, in case the module enters programming mode or fault mode, it will output states of programming mode or fault mode.
- In short, whether the module output is enabled will affect its output status under fault mode and program mode.
- If the module is hot-swamped or turned on again after power loss after its output is enabled, it will return back to the initial status and the output is disabled again. The output will be enabled again once the module receives another output command from the controller.
- After a full-download, the user program in the controller stops operation and the slave module enters program mode automatically. In this case, if the module output is enabled before the download, it will output the program mode state; if the module output is disabled before the download, it will keep the initial status.
- After the full-download, the user program operation can be executed through the following two methods:
- Turn the key switch on controller front-panel to “RUN”.
- Turn the key switch on controller front-panel to “REM” and execute “Run” command in the programming software.

Program Mode

- Program mode is a working mode of the controller to modify, edit and download user programs. In program mode, user programs are halted and cannot be restarted through configuration software. Not under control, digital output module retains output (Hold Last State) or outputs a state (ON or OFF) preset in the configuration, known as the Program Mode State.
- Controller can make the slave station enter or exit program mode through the following methods:
- Turn the key switch to “PRG” to force all modules into program mode. Then, operation of user program halts, module outputs program mode state.
- Turn the key switch to “RUN”, module exits program mode and controller runs the user program.
- Please note that if the module has never been output enabled, it does not output programming mode value even it enters program mode.
- After the full-download of user program, output module automatically enters program mode no matter whether the key switch on the controller is located at “PRG”. If the module has never output any data before the download (e.g. output is not enabled), it will retain the initial status and does not output. If the module output has been enabled before the download, module outputs program mode state.
- Under program mode, whether the module retains output (Hold Last State) or outputs program mode state is configured by user parameter “Program Mode Output”, whose default value is “Hold Last State”. Program mode state is configured by user parameter “Program Mode State”, default output of which is OFF (open). Modifications will only be effective after the full download. Special notes shall be taken that: after the full down and before the operation, the module is under program mode and outputs previous program mode state. The new state will only replace the previous one after the operation of user program.

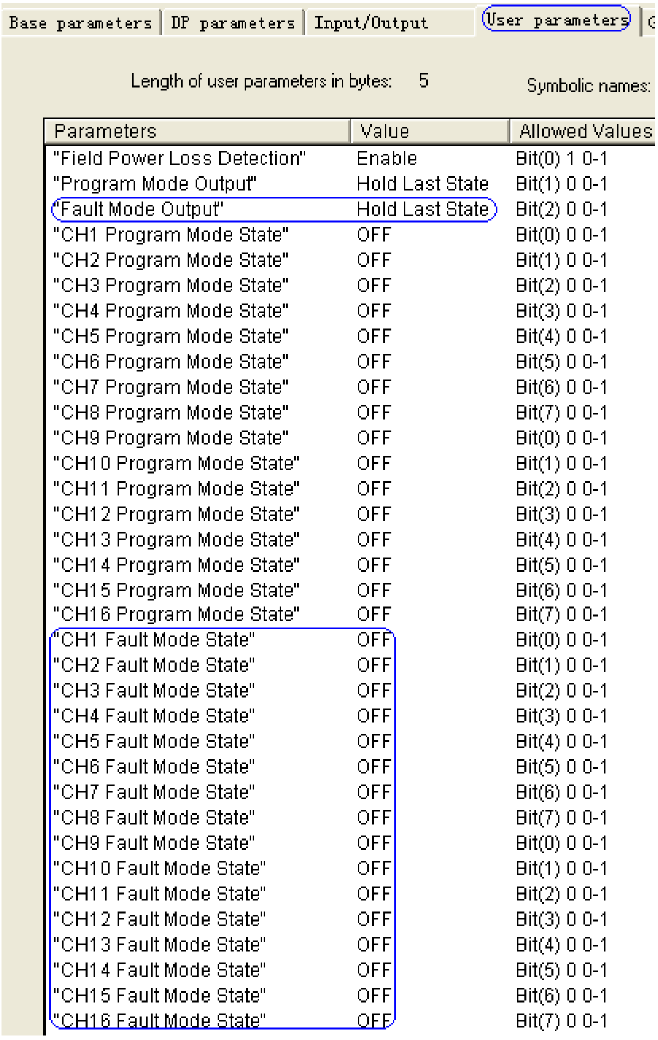


Parameters	Value	Allowed Values
"Field Power Loss Detection"	Enable	Bit(0) 1 0-1
"Program Mode Output"	Hold Last State	Bit(1) 0 0-1
"Fault Mode Output"	Hold Last State	Bit(2) 0 0-1
"CH1 Program Mode State"	OFF	Bit(0) 0 0-1
"CH2 Program Mode State"	OFF	Bit(1) 0 0-1
"CH3 Program Mode State"	OFF	Bit(2) 0 0-1
"CH4 Program Mode State"	OFF	Bit(3) 0 0-1
"CH5 Program Mode State"	OFF	Bit(4) 0 0-1
"CH6 Program Mode State"	OFF	Bit(5) 0 0-1
"CH7 Program Mode State"	OFF	Bit(6) 0 0-1
"CH8 Program Mode State"	OFF	Bit(7) 0 0-1
"CH9 Program Mode State"	OFF	Bit(0) 0 0-1
"CH10 Program Mode State"	OFF	Bit(1) 0 0-1
"CH11 Program Mode State"	OFF	Bit(2) 0 0-1
"CH12 Program Mode State"	OFF	Bit(3) 0 0-1
"CH13 Program Mode State"	OFF	Bit(4) 0 0-1
"CH14 Program Mode State"	OFF	Bit(5) 0 0-1
"CH15 Program Mode State"	OFF	Bit(6) 0 0-1
"CH16 Program Mode State"	OFF	Bit(7) 0 0-1

Figure 9.3: LK710 Output Setting under Program Mode

Communication Failure

- When communication failure occurs, the communication between controller and output module breaks and the "RUN" light flashes. The module may be in one of the following states in communication failure:
- After power on, module cannot establish communication with the controller, then the module will retain the initial status and its output is not enabled.
- Module in operation when communication failure (offline) occurs: module retains output (Hold Last State) or outputs a state (ON or OFF) preset in the configuration, known as the Fault Mode State. Whether the module retains output or outputs fault mode state can be configured in software.
- Module in program mode when communication failure occurs: module enters fault mode and outputs fault mode state. When failure recovered, module automatically returns to program mode and outputs program mode state again.
- If the module output has not been enabled, the module does not output fault mode state even if any communication failure occurs.
- Under fault mode, whether the module retains output (Hold Last State) or outputs fault mode state is configured by user parameter "Fault Mode Output", whose default value is "Hold Last State". Fault mode state is configured by user parameter "Fault Mode State", default output of which is OFF (open).



Base parameters | DP parameters | Input/Output | User parameters

Length of user parameters in bytes: 5

Symbolic names:

Parameters	Value	Allowed Values
"Field Power Loss Detection"	Enable	Bit(0) 1 0-1
"Program Mode Output"	Hold Last State	Bit(1) 0 0-1
"Fault Mode Output"	Hold Last State	Bit(2) 0 0-1
"CH1 Program Mode State"	OFF	Bit(0) 0 0-1
"CH2 Program Mode State"	OFF	Bit(1) 0 0-1
"CH3 Program Mode State"	OFF	Bit(2) 0 0-1
"CH4 Program Mode State"	OFF	Bit(3) 0 0-1
"CH5 Program Mode State"	OFF	Bit(4) 0 0-1
"CH6 Program Mode State"	OFF	Bit(5) 0 0-1
"CH7 Program Mode State"	OFF	Bit(6) 0 0-1
"CH8 Program Mode State"	OFF	Bit(7) 0 0-1
"CH9 Program Mode State"	OFF	Bit(0) 0 0-1
"CH10 Program Mode State"	OFF	Bit(1) 0 0-1
"CH11 Program Mode State"	OFF	Bit(2) 0 0-1
"CH12 Program Mode State"	OFF	Bit(3) 0 0-1
"CH13 Program Mode State"	OFF	Bit(4) 0 0-1
"CH14 Program Mode State"	OFF	Bit(5) 0 0-1
"CH15 Program Mode State"	OFF	Bit(6) 0 0-1
"CH16 Program Mode State"	OFF	Bit(7) 0 0-1
"CH1 Fault Mode State"	OFF	Bit(0) 0 0-1
"CH2 Fault Mode State"	OFF	Bit(1) 0 0-1
"CH3 Fault Mode State"	OFF	Bit(2) 0 0-1
"CH4 Fault Mode State"	OFF	Bit(3) 0 0-1
"CH5 Fault Mode State"	OFF	Bit(4) 0 0-1
"CH6 Fault Mode State"	OFF	Bit(5) 0 0-1
"CH7 Fault Mode State"	OFF	Bit(6) 0 0-1
"CH8 Fault Mode State"	OFF	Bit(7) 0 0-1
"CH9 Fault Mode State"	OFF	Bit(0) 0 0-1
"CH10 Fault Mode State"	OFF	Bit(1) 0 0-1
"CH11 Fault Mode State"	OFF	Bit(2) 0 0-1
"CH12 Fault Mode State"	OFF	Bit(3) 0 0-1
"CH13 Fault Mode State"	OFF	Bit(4) 0 0-1
"CH14 Fault Mode State"	OFF	Bit(5) 0 0-1
"CH15 Fault Mode State"	OFF	Bit(6) 0 0-1
"CH16 Fault Mode State"	OFF	Bit(7) 0 0-1

Figure 9.4: LK710 Output Setting under Fault Mode

Over-Current Protection

- LK710 provides over-current protection function to protect the module in case of power surge, such as, output short circuit. The module achieves the over-current protection by connecting a self-recover fuse in series to the circuit. Every two points share a self-recover fuse.

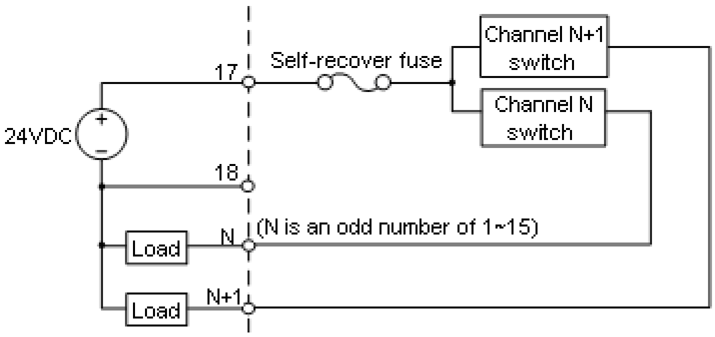


Figure 9.5: Over-Current Protection Circuit of LK710 Channels

9.1.6 Diagnosis Specifications

PowerPro V4 configuration software adopts external diagnosis library to check and acquire all kinds of diagnosis information, such as whether the module and its channels are operating normally, whether the field power supplying smoothly and whether the module parameters are set correctly.

For the DP slave station modules, the DP slave station expansion diagnosis function block (HS_DPSlaveALarm) shall be called to check the DP module at any address (DP_Addr) on the PROFIBUS-DP link, as shown in Figure 9.6.

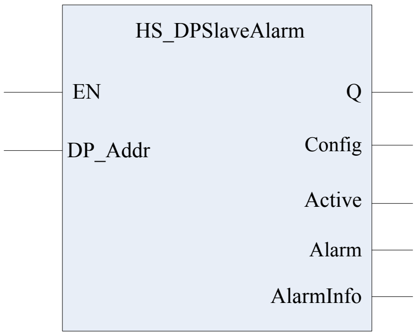


Figure 9.6: Expansion Diagnosis Function Block for DP Slave Station

For detailed usage of DP Expansion Diagnosis Function Block, please refer to LK Large Scale PLC Instruction Manual. Users shall note that the Diagnosis library is an external library that shall be first installed in the Library Manager before use.

The diagnosis information of DP slave station modules can be classified to 3 categories: device diagnosis, identifier diagnosis and channel diagnosis. All diagnosis data exist in the form of block structure.

Field Power Loss Detection

- LK710 provides the field power loss detection. Whether to enable this function can be selected by user parameter "FieldPowerLossDetection", the default setting of which is "Enable". Modifications can only be effective after the full download.
- As shown in Figure 9.7, terminal "17" connects to the positive end of field power supply while terminal "18" connects to its negative end. LK710 carries out power loss detection by checking the changes of input voltage between these two terminals. In case of any failure, the failure status will be reported to the controller as the diagnosis data.

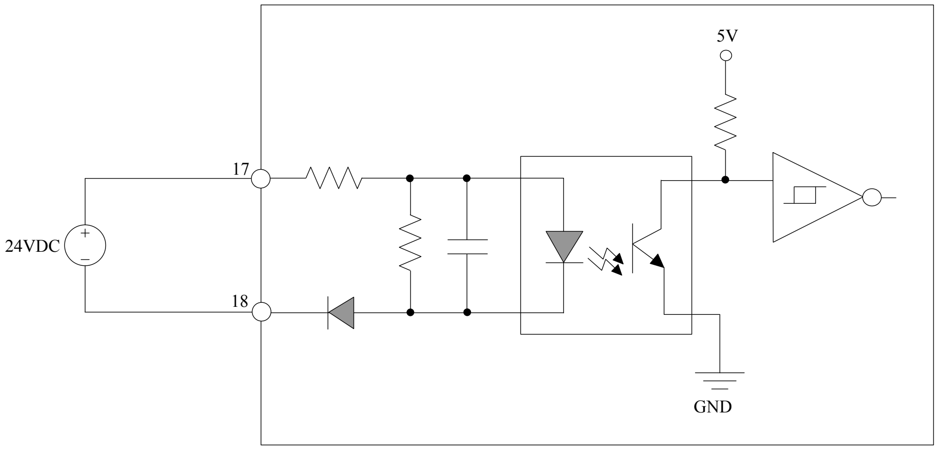


Figure 9.7: Field Power Loss Detection Circuit of LK710

- When the field 24VDC power supply is lost (line-break or power supply output voltage <5VDC), LK710 device diagnosis data area generates diagnosis byte "0x04" (Bit2 of this diagnosis byte =1), and reports this diagnosis byte to the controller in the next scan period.
- When the field 24VDC power supply is recovered (power supply output voltage in the range of 10~31.2VDC), LK710 device diagnosis data area generates a new diagnosis byte "0x00" (Bit2 of this diagnosis byte =0), and reports this diagnosis byte to the controller in the next scan period.
- LK710 module will only report the diagnosis data once respectively when failure occurs and is recovered.

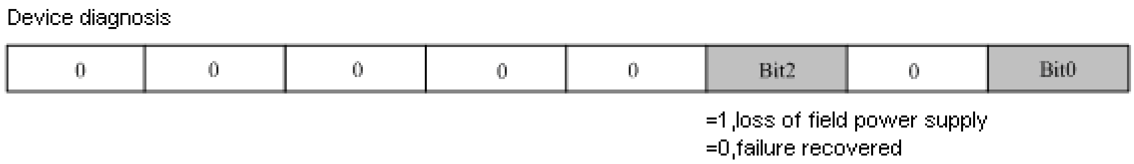


Figure 9.8: LK710 Diagnosis Byte

- Field power loss detection is a kind of device diagnosis. The definition of its diagnosis byte is as shown in Figure 9.8. After the DP slave station expansion diagnosis function block is called, the diagnosis data reported by LK710 will be stored in the output field "DevDiag.Data[1]" of the function block output parameter "AlarmInfo", as shown in Table 9.2.

Device Diagnosis	Value	Definition
AlarmInfo.DevDiag.Data[1]	0X04	Power Loss of Field Power Supply
	0x00	Failure recovered or no diagnosis data

Table 9.2: Definition of LK710 Diagnosis Information

9.1.7 Parameter Specifications

The controller can only read and write the I/O information regularly after the module entered data exchange mode after the initialization. Therefore, in order to provide correct parameter information in the initialization process, users shall first set the parameters in the PLC hardware configuration.

Communication Parameters

- Supporting PROFIBUS-DP slave station protocol, LK710 completes data exchanges and diagnosis information reporting with the controller and other DP master stations. The slave station adopts a unique communication address, which is determined by the backplane number and the slot number of the LK710 module. The communication address shall be correctly filled in the DP parameter field in the configuration, as shown in Figure 9.9. Other parameters normally need no modifications.

Refer to Chapter 2: Backplanes for details of communication address assignment.

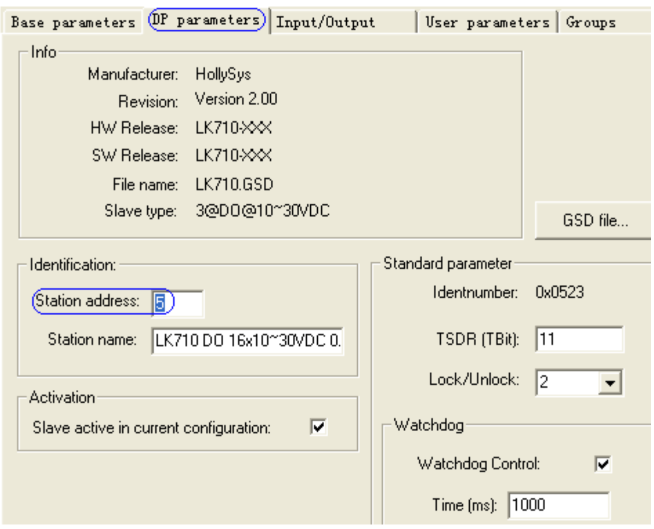


Figure 9.9: Setting of LK710 Communication Parameters

User Parameters

- User parameters are used to configure the module's operating mode. They are written into the controller during the download of user program and will not be read in every scanning circle. Each parameter has a default value that can be changed according to requirements of the project. User parameters do not support online modification; therefore they can only be effective after the full download.
- LK710 module has totally 5 bytes of user parameters.

Parameter Name	Parameter Definition	Value Options
Field Power Loss Detection	Enable power loss detection	0: Disable, disabled; 1: enable, enabled (default);
Program Mode Output	Setting of program mode output	O: Hold Last Sate (default); 1: output program mode state
Fault Mode Output	Setting of fault Mode Output	O: Hold Last Sate (default); 1: output fault mode state
CH1 Program Mode State	Program mode state of Channel 1	0: OFF open (default); 1: ON close
CH2 Program Mode State	Program mode state of Channel 2	0: OFF open (default); 1: ON close
CH3 Program Mode State	Program mode state of Channel 3	0: OFF open (default); 1: ON close
CH4 Program Mode State	Program mode state of Channel 4	0: OFF open (default); 1: ON close
CH5 Program Mode State	Program mode state of Channel 5	0: OFF open (default); 1: ON close
CH6 Program Mode State	Program mode state of Channel 6	0: OFF open (default); 1: ON close
CH7 Program Mode State	Program mode state of Channel 7	0: OFF open (default); 1: ON close
CH8 Program Mode State	Program mode state of Channel 8	0: OFF open (default); 1: ON close
CH9 Program Mode State	Program mode state of Channel 9	0: OFF open (default); 1: ON close
CH10 Program Mode State	Program mode state of Channel 10	0: OFF open (default); 1: ON close
CH11 Program Mode State	Program mode state of Channel 11	0: OFF open (default); 1: ON close
CH12 Program Mode State	Program mode state of Channel 12	0: OFF open (default); 1: ON close
CH13 Program Mode State	Program mode state of Channel 13	0: OFF open (default); 1: ON close
CH14 Program Mode State	Program mode state of Channel 14	0: OFF open (default); 1: ON close
CH15 Program Mode State	Program mode state of Channel 15	0: OFF open (default); 1: ON close
CH16 Program Mode State	Program mode state of Channel 16	0: OFF open (default); 1: ON close
CH1 Fault Mode State	Fault Mode State of Channel 1	0: OFF open (default); 1: ON close
CH2 Fault Mode State	Fault Mode State of Channel 2	0: OFF open (default); 1: ON close
CH3 Fault Mode State	Fault Mode State of Channel 3	0: OFF open (default); 1: ON close
CH4 Fault Mode State	Fault Mode State of Channel 4	0: OFF open (default); 1: ON close
CH5 Fault Mode State	Fault Mode State of Channel 5	0: OFF open (default); 1: ON close
CH6 Fault Mode State	Fault Mode State of Channel 6	0: OFF open (default); 1: ON close
CH7 Fault Mode State	Fault Mode State of Channel 7	0: OFF open (default); 1: ON close
CH8 Fault Mode State	Fault Mode State of Channel 8	0: OFF open (default); 1: ON close
CH9 Fault Mode State	Fault Mode Status of Channel 9	0: OFF open (default); 1: ON close
CH10 Fault Mode State	Fault Mode State of Channel 10	0: OFF open (default); 1: ON close
CH11 Fault Mode State	Fault Mode State of Channel 11	0: OFF open (default); 1: ON close
CH12 Fault Mode State	Fault Mode State of Channel 12	0: OFF open (default); 1: ON close
CH13 Fault Mode State	Fault Mode State of Channel 13	0: OFF open (default); 1: ON close
CH14 Fault Mode State	Fault Mode State of Channel 14	0: OFF open (default); 1: ON close
CH15 Fault Mode State	Fault Mode State of Channel 15	0: OFF open (default); 1: ON close
CH16 Fault Mode State	Fault Mode State of Channel 16	0: OFF open (default); 1: ON close

Table 9.3: List of LK710 User Parameters

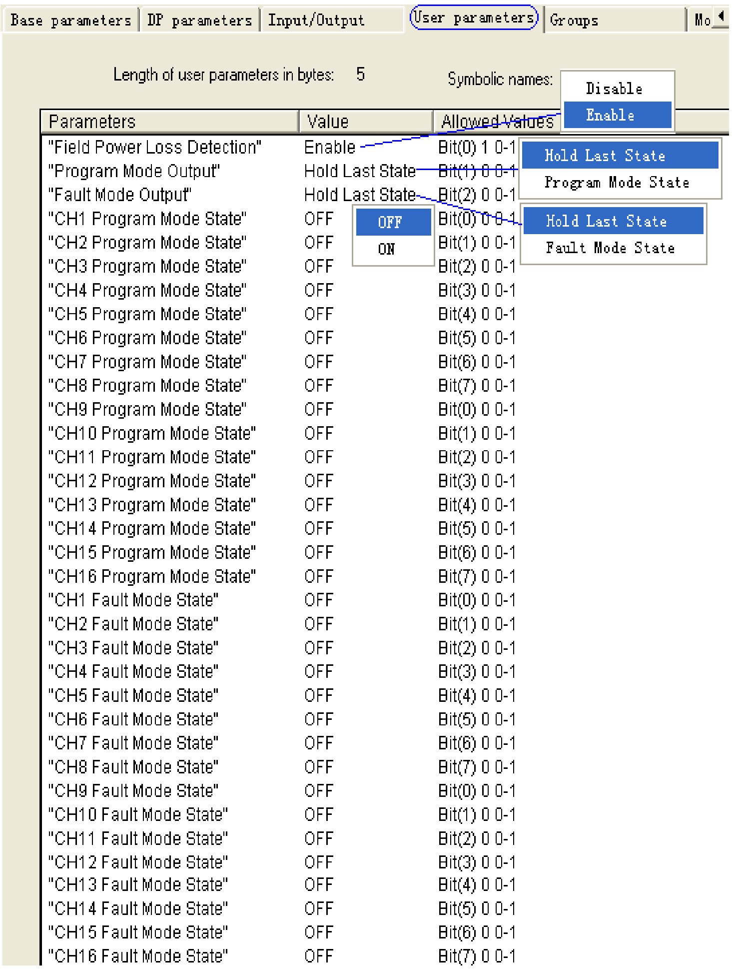


Figure 9.10: Setting of LK710 User Parameters

Specifications of Data Area

- Input data are the data uploaded from the slave station that will be updated in every scan period. Output data are data that sent to the slave station by the controller in every scan period and can be modified online when the user program is running.
- LK710 has 2 bytes of output data to control the close and open of its 16 channels of outputs. Consisted of 2 bytes, LK710 input data feeds back the status of the channels in the form of readback data. Bit0~Bit15 are respectively corresponding to channel 1 ~channel 16, as shown in Table 9.4.
- The channel readback data return the output status of the channel to the controller for the programming of users.

Area Definition	Data Length	Definition	Value Range
Output Data (%Q)	1WORD	Output status of channel 1~channel 16 Bit0~Bit15 are respectively corresponding to channel 1 ~ channel 16, 1=close; 0=close	0x0000~0xFFFF
Input Data (%I)	1WORD	Readback of channel 1~channel 16 output status Bit0~Bit15 are respectively corresponding to channel 1 ~ channel 16, 1=close; 0=close	0x0000~0xFFFF

Table 9.4: List of LK710 Input/Output Data

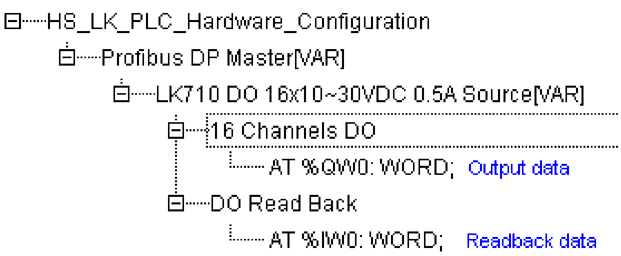


Figure 9.11: LK710 Input/Output Data

9.1.8 Module Installation and Un-installation

Refer to chapter I on "Module Insertion Mechanical keys" and "Module Insertion and Removable" for more details.

9.1.9 Technical Specification

LK710 16-Channel 24VDC DO module	
System Power Supply	
Operating voltage	24VDC(-15%~+20%)
Backplane Current	70mA max@24V DC
Output Channel	
Number of Channels	16 channels
Output Switch	MOSFET
Isolation Voltage	System to field 500VAC@1min, current leak 5mA
Output Rated Voltage	24VDC
Output Voltage Range	10VDC~31.2VDC
Output Rated Current Each point Each module	 0.5A@40℃&0.4A@60℃ (linear decreasing) 8A@40℃&6.4A@60℃ (linear decreasing)
Inrush Current on Each Point	1A, lasing 10ms, period 2s@60℃
Over-Current Protection	Every 2 points share a self-recover fuse
Minimum load current	3mA / point
Maximum On-state Voltage Drop	150mV@0.5A
Maximum OFF-state Current Leak	1mA / point
Output Delay Time OFF→ON ON→OFF	 1ms (maximum) 1ms (maximum)
Configurable fault mode output state of each point	Hold Last State (default); ON of OFF
Configurable program mode output state of each point	Hold Last State (default); ON of OFF
Failure Diagnosis and Hot Swap	
Field Power Loss Detection	Field power loss: diagnosis byte 0x04; Power recovered: diagnosis byte 0x00
Hot Swap	Support
Communication Bus	
Protocol	PROFIBUS-DP Slave Station, in accordance with IEC61158-3/EN50170 standards
Baud Rate	Baud Rate Options: 1.5Mbps, 500Kbps, 187.5Kbps, 93.75Kbps, 45.45Kbps, 31.25Kbps, 19.2Kbps, 9.6Kbps
Media	Communication bus is connected to the backplane through euro connector, hot redundant communication media
Physical Features	
Mechanic Keys to Prevent Incorrect Insertion	E0
Installation	LK local backplane or expansion backplane
Dimension	Width × Height × Depth = 35mm×100mm×100mm
Casing Protection Level	IEC60529 IP20
Weight	180g
Working Environment	
Working Temperature	0℃~60℃
Working Relative Humidity	5%~95%, no condensate
Storage Temperature	-40℃~70℃
Storage relative Humidity	5%~95%, no condensate

Table 9.5: Technical Specification of LK710 Module

9.2 LK711 8-CHANNEL 10~60VAC DO MODULE

9.2.1 Features

- 8 channels of TRIAC outputs
- Output voltage range: 10~60VAC
- Support ProfiBus-DP Slave Station Protocol
- Fault Mode Output
- Program mode output
- Output readback;
- Field Power Loss Detection
- Over-Current Protection
- System to field isolation, inter-group isolation
- Supports hot swap

9.2.2 Operation Principles

The controller sends output data to LK711 through PROFIBUS-DP bus to drive the circuit output control signals to open or close the TRIAC in order to drive or open the field load.

With a voltage range of 10~60VAC, the external 24VAC field power supply shall be electrically isolated from the internal 24VDC system power supply of LK711.

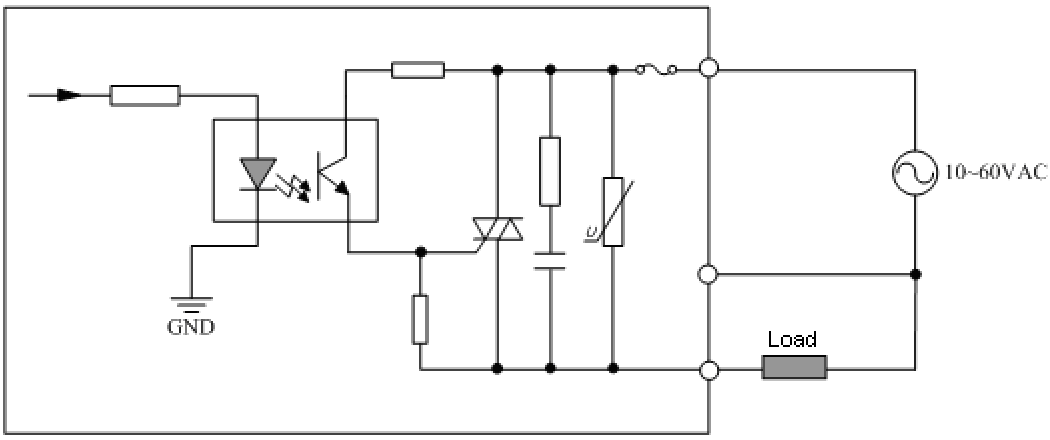


Figure 9.12: LK711 Channel Interface Circuit

9.2.3 Indicators Definition

RUN indicator (Green)	On	Communication is established, module in normal operation
	Flash	Communication is not established or communication error
	Off	Power off of the module
Channel01~8 Indicators (Yellow)	On	The channel is closed
	Off	The channel is opened

Table 9.6: Definition of LK711 Indicators

Specifications of RUN green light are as follows:

- After the power is on, the module waits for initialization data while the green light flashes with a frequency of 4 times per second.
- After the initialization is completed, the green light is constantly on to indicate the module in normal operation; if any error occurs in the initialization, then the communication is not established and the green light keeps flashing. The connection of DP cables and communication parameters settings then shall be checked to see if there are any errors.
- When the module is in normal operation, the green light is constantly on. When communication failure occurs, and the communication with the controller breaks, the green light flashes. The LK711 module automatically enters fault mode. It retains output or outputs fault mode state. When failure recovered and the communication to the controller re-established, the green light is constantly on again and module exits fault mode.

9.2.4 Wiring Specifications

The contact type of LK711 output is dry contact point; hence the module needs a field power supply to drive the output of the optical coupler. LK711 module is installed on LK series backplanes that support two types of wirings: terminal wiring and prefabricated cable wring.

Wiring to Backplane Terminals

- As shown in Table 9.7, the 8 channel outputs of LK711 are divided into 4 groups. Each group contains 2 channels and are supplied separated by the field AC power. Isolation voltage of the inter-group isolation is 500VAD.

Channel Number		Terminal Number	Channel Number		Terminal Number
Group 1	Channel 1	01	Group 3	Channel 5	09
	Channel 2	02		Channel 6	10
	Field Power Supply 1	03/04		Field Power Supply 3	11/12
Group 2	Channel 3	05	Group 4	Channel 7	13
	Channel 4	06		Channel 8	14
	Field Power Supply 2	07/08		Field Power Supply 4	15/16

Table 9.7: Definitions of LK711 Backplane Wiring Terminals

- LK711 module is wired through the correspondence terminals under the backplane installation slot. The relationship between each channel and terminal is shown in Figure 9.13. One ends of the 8 channel loads connect to the wiring terminals of their correspondence channels while the other ends connect to each field power supply.

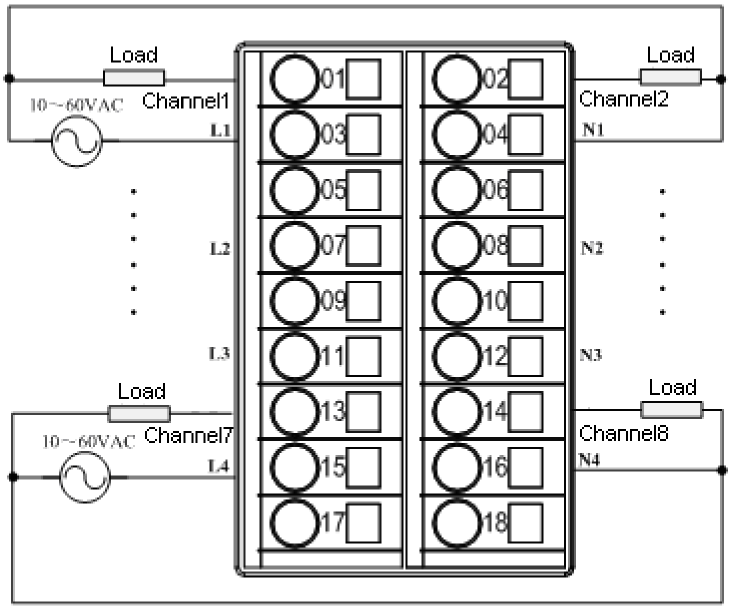


Figure 9.13: Wiring of LK711 Backplane Terminals

In the wiring, the following shall be noted:

- The 8 channel outputs of LK711 are divided in to 4 groups of 2 channels. Groups are isolated from each other with an isolation voltage of 500VAC. Each group is supplied by separated wring terminals of field power supply. When there is no requirement of inter-channel isolation, the 8 channels can also share one field power supply.
- Terminals "1", "2", "5", "6", "9", "10", "13", "14" are the digital output terminals of channel 1~8.
- Terminals "3", "7", "11", "15" are the input terminals of field power supply that normally connect by live line.
- Terminals "4", "8", "12", "16" are the return terminals of field power supply that normally connect by ground line.
- Terminal "17" and "18" shall not be connected in the wiring.
- A single terminal shall not be connected to many wires; therefore multiple-point connection can be established through bus bar or transferring terminal board.

Wiring to Terminal Module

Please refer to the information found on Chapter 12: Terminal Module.

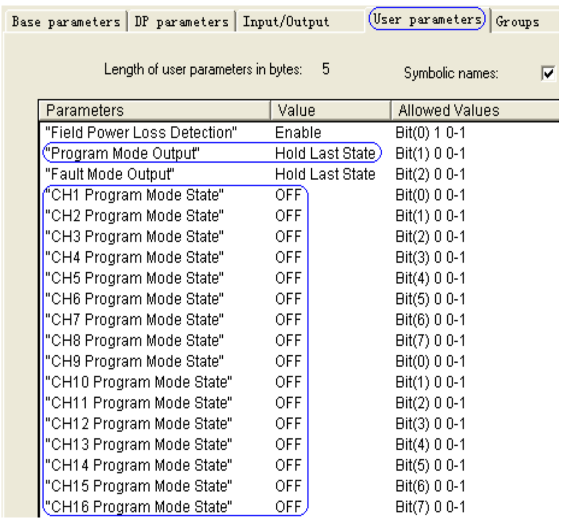
9.2.5 Function Specifications

Enable Output

- After the output module is power on, if it does not receive any output command from the controller, it will keep the initial mode and does no output. The output of an initial mode module is disabled. In this case, the module will keep this initial status even it enters program mode or fault mode.
- After the operation of user programs, the controller sends output command to the output module through PROFIBUS-DP bus. Output module receives command and outputs data. The output of a slave module is enabled once the module outputs an command sent by the controller. When the module output is enabled, in case the module enters programming mode or failure mode, it will output states of program mode or fault mode.
- In short, whether the module output is enabled will affect its output status under fault mode and program mode.
- If the module is hot-swamped or turned on again after power loss after its output is enabled, it will return back to the initial status and the output is disabled again. The output will be enabled again once the module receives another output command from the controller.
- After a full-download, the user program in the controller stops operation and the slave module enters program mode automatically. In this case, if the module output is enabled before the download, it will output the program mode state; if the module output is disabled before the download, it will keep the initial status.
- After the full-download, the user program operation can be executed through the following two methods:
- Turn the key switch on controller front-panel to “RUN”.
- Turn the key switch on controller front-panel to “REM” and execute “Run” command in the programming software.

Program Mode

- Program mode is a working mode of the controller to modify, edit and download user programs. In program mode, user programs are halted and cannot be restarted through configuration software. Not under control, digital output module retains output (Hold Last State) or outputs a state (ON or OFF) preset in the configuration, known as the Program Mode State.
- Controller can make the slave station enter or exit program mode through the following methods:
- Turn the key switch to “PRG” to force all modules into program mode. Then, operation of user program halts, module outputs program mode state.
- Turn the key switch to “RUN”, module exits program mode and controller runs the user program.
- Please note that if the module has never been output enabled, it does not output programming mode value even it enters program mode.
- After the full-download of user program, output module automatically enters program mode no matter whether the key switch on the controller is located at “PRG”. If the module has never output any data before the download (e.g. output is not enabled), it will retain the initial status and does not output. If the module output has been enabled before the download, module outputs program mode state.
- Under program mode, whether the module retains output (Hold Last State) or outputs program mode state is configured by user parameter “Program Mode Output”, whose default value is “Hold Last State”. Program mode state is configured by user parameter “Program Mode State”, default output of which is OFF (open). Modifications will only be effective after the full download. Special notes shall be taken that: after the full down and before the operation, the module is under program mode and outputs previous program mode state. The new state will only replace the previous one after the operation of user program.

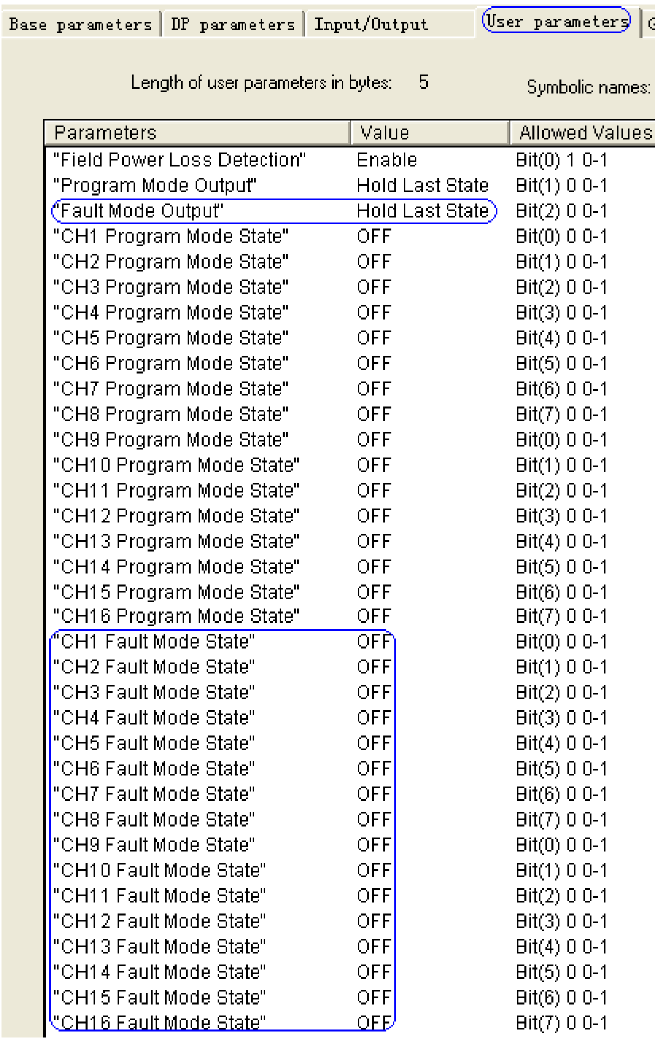


Parameters	Value	Allowed Values
"Field Power Loss Detection"	Enable	Bit(0) 1 0-1
"Program Mode Output"	Hold Last State	Bit(1) 0 0-1
"Fault Mode Output"	Hold Last State	Bit(2) 0 0-1
"CH1 Program Mode State"	OFF	Bit(0) 0 0-1
"CH2 Program Mode State"	OFF	Bit(1) 0 0-1
"CH3 Program Mode State"	OFF	Bit(2) 0 0-1
"CH4 Program Mode State"	OFF	Bit(3) 0 0-1
"CH5 Program Mode State"	OFF	Bit(4) 0 0-1
"CH6 Program Mode State"	OFF	Bit(5) 0 0-1
"CH7 Program Mode State"	OFF	Bit(6) 0 0-1
"CH8 Program Mode State"	OFF	Bit(7) 0 0-1
"CH9 Program Mode State"	OFF	Bit(0) 0 0-1
"CH10 Program Mode State"	OFF	Bit(1) 0 0-1
"CH11 Program Mode State"	OFF	Bit(2) 0 0-1
"CH12 Program Mode State"	OFF	Bit(3) 0 0-1
"CH13 Program Mode State"	OFF	Bit(4) 0 0-1
"CH14 Program Mode State"	OFF	Bit(5) 0 0-1
"CH15 Program Mode State"	OFF	Bit(6) 0 0-1
"CH16 Program Mode State"	OFF	Bit(7) 0 0-1

Figure 9.14: LK711 Output Setting under Program Mode

Communication Failure

- When communication failure occurs, the communication between controller and output module breaks and the “RUN” light flashes. The module may be in one of the following states in communication failure:
- After power on, module cannot establish communication with the controller, then LK711 will retain the initial status and its output is not enabled.
- Module in operation when communication failure (offline) occurs: module retains output (Hold Last State) or outputs a state (ON or OFF) preset in the configuration, known as the Fault Mode State. Whether the module retains output or outputs fault mode state can be configured in software.
- Module in program mode when communication failure occurs: module enters fault mode and outputs fault mode state. When failure recovered, module automatically returns to program mode and outputs program mode state again.
- If the module output has not been enabled, the module does not output fault mode state even if any communication failure occurs.
- Under fault mode, whether the module retains output (Hold Last State) or outputs fault mode state is configured by user parameter “Fault Mode Output”, whose default value is “Hold Last State”. Fault mode state is configured by user parameter “Fault Mode State”, default output of which is OFF (open). Parameters of each channel are configured separately without interfere to others.



Base parameters | DP parameters | Input/Output | User parameters

Length of user parameters in bytes: 5 Symbolic names:

Parameters	Value	Allowed Values
"Field Power Loss Detection"	Enable	Bit(0) 1 0-1
"Program Mode Output"	Hold Last State	Bit(1) 0 0-1
"Fault Mode Output"	Hold Last State	Bit(2) 0 0-1
"CH1 Program Mode State"	OFF	Bit(0) 0 0-1
"CH2 Program Mode State"	OFF	Bit(1) 0 0-1
"CH3 Program Mode State"	OFF	Bit(2) 0 0-1
"CH4 Program Mode State"	OFF	Bit(3) 0 0-1
"CH5 Program Mode State"	OFF	Bit(4) 0 0-1
"CH6 Program Mode State"	OFF	Bit(5) 0 0-1
"CH7 Program Mode State"	OFF	Bit(6) 0 0-1
"CH8 Program Mode State"	OFF	Bit(7) 0 0-1
"CH9 Program Mode State"	OFF	Bit(0) 0 0-1
"CH10 Program Mode State"	OFF	Bit(1) 0 0-1
"CH11 Program Mode State"	OFF	Bit(2) 0 0-1
"CH12 Program Mode State"	OFF	Bit(3) 0 0-1
"CH13 Program Mode State"	OFF	Bit(4) 0 0-1
"CH14 Program Mode State"	OFF	Bit(5) 0 0-1
"CH15 Program Mode State"	OFF	Bit(6) 0 0-1
"CH16 Program Mode State"	OFF	Bit(7) 0 0-1
"CH1 Fault Mode State"	OFF	Bit(0) 0 0-1
"CH2 Fault Mode State"	OFF	Bit(1) 0 0-1
"CH3 Fault Mode State"	OFF	Bit(2) 0 0-1
"CH4 Fault Mode State"	OFF	Bit(3) 0 0-1
"CH5 Fault Mode State"	OFF	Bit(4) 0 0-1
"CH6 Fault Mode State"	OFF	Bit(5) 0 0-1
"CH7 Fault Mode State"	OFF	Bit(6) 0 0-1
"CH8 Fault Mode State"	OFF	Bit(7) 0 0-1
"CH9 Fault Mode State"	OFF	Bit(0) 0 0-1
"CH10 Fault Mode State"	OFF	Bit(1) 0 0-1
"CH11 Fault Mode State"	OFF	Bit(2) 0 0-1
"CH12 Fault Mode State"	OFF	Bit(3) 0 0-1
"CH13 Fault Mode State"	OFF	Bit(4) 0 0-1
"CH14 Fault Mode State"	OFF	Bit(5) 0 0-1
"CH15 Fault Mode State"	OFF	Bit(6) 0 0-1
"CH16 Fault Mode State"	OFF	Bit(7) 0 0-1

Figure 9.15: LK711 Output Setting under Fault Mode

Over-Current Protection

- LK711 provides over-current protection function to protect the module components in case of power surge, such as, output short circuit. The module achieves the over-current protection by connecting the circuit in series with a fuse, 235.003P fuse (rated current 3A). Each group employs 1 fuse.

Refer to Appendix 1: Fuse Replacement in page 303 for the fuse replacement.

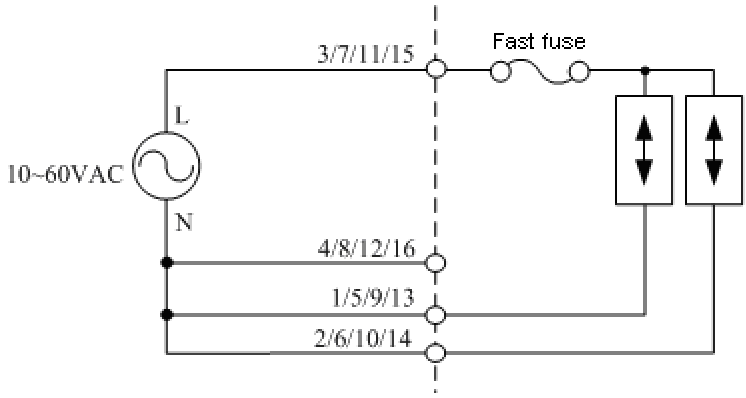


Figure 9.16: Over-Current Protection Circuit of LK711 Channels

9.2.6 Diagnosis Specifications

PowerPro V4 configuration software adopts external diagnosis library to check and acquire all kinds of diagnosis information, such as whether the module and its channels are operating normally, whether the field power supplying smoothly and whether the module parameters are set correctly.

For the DP slave station modules, the DP slave station expansion diagnosis function block (HS_DPSlaveALarm) shall be called to check the DP module at any address (DP_Addr) on the PROFIBUS-DP link, as shown in Figure 9.17.

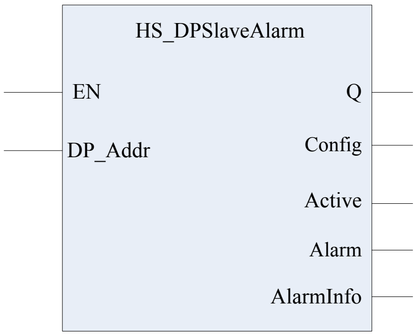


Figure 9.17: Expansion Diagnosis Function Block for DP Slave Station

For detailed usage of DP Expansion Diagnosis Function Block, please refer to LK Large Scale PLC Instruction Manual. Users shall note that the Diagnosis library is an external library that shall be first installed in the Library Manager before use.

The diagnosis information of DP slave station modules can be classified to 3 categories: device diagnosis, identifier diagnosis and channel diagnosis. All diagnosis data exist in the form of block structure.

- Device Diagnosis: records of the overall diagnosis information of the module, such as, power loss of field power supply.
- Identifier Diagnosis: records of whether the module has diagnosis information.
- Channel Diagnosis: records of the channel level diagnosis information, such as disconnection and rang exceeding.

Field Power Loss Detection

- LK711 provides field power loss detection. Each group employs a field power supply. Whether to enable the field power loss detection of a group is selected through user parameter “FieldPowerLossDetection”, the default value of which is “Enable".
- The power loss detection of each group can be enabled separately without inference to each other. Parameter changes can only be effective after a full download.
- Each group of output has two wiring terminals connect to the field power supply. LK711 carries out power loss detection by checking the changes of input voltage between these two terminals. In case of any failure, the failure status will be reported to the controller as the diagnosis data.

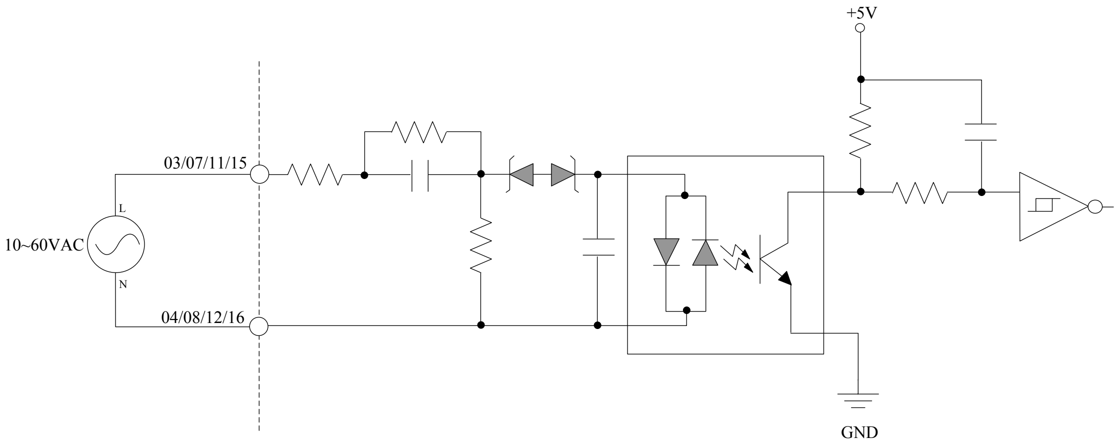


Figure 9.18: Field Power Loss Detection Circuit of LK711

- LK711 employs 4 independent external field power supplies and it carries out the power loss diagnosis to these 4 field power supplies at the same time. To determine which one of the field power supplies get loss, device diagnosis is not enough. Therefore further channel diagnoses shall be executed. When the power of a group is lost, the diagnosis shows that failure occurs in the 2 output channels of the group and power loss in the channel.
- When the field 24VAC power supply of a group is lost (line-break or power supply output voltage <8VAC), LK711 device diagnosis data area generates diagnosis byte “0x05” (Bit2 of device diagnosis byte =1). At the same time, diagnosis areas of the two power loss channels generate diagnosis data “17” (failure type value 17 indicates field power loss of the channel). Module then reports the diagnosis data to the controller in the next scan period.
- When the field 24VAC power supply of a group is recovered (output voltage in the range of 10~60VAC), LK711 device diagnosis area generates a new diagnosis byte “0x00” while the two channel diagnosis areas generate new diagnosis data “0” (failure type value 0 indicates that channel failure is recovered). Module then reports the diagnosis data to the controller in the next scan period.
- LK711 module will only report the diagnosis data once respectively when failure occurs and is recovered.

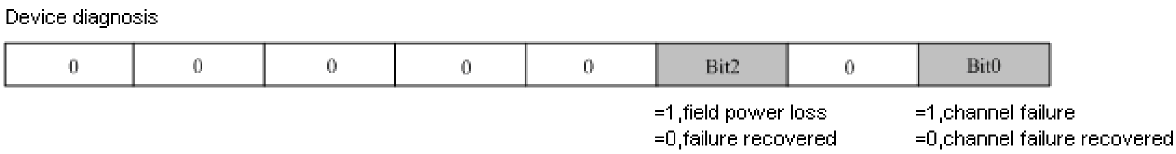


Figure 9.19: Device Diagnosis Byte of LK711 Module

After the DP slave station expansion diagnosis function block (HS_DPSlaveAlarm) is called, the device diagnosis and channel diagnosis data reported by LK711 will be stored in the corresponding fields of the output parameter “AlarmInfo”, as shown in Table 9.8

Diagnosis Information		Value	Definition
Device Diagnosis	ALarmInfo.DevDiag.Data[1]	0x05	Field Power Loss
		0x00	Failure Recovered
Channel Diagnosis	ChDiag.Module.Channel.ChNo	1~8	Channel Number of the Failure
	ChDiag.Module.Channel.Error	17	Field Power Loss of the channel
		0	Channel Failure Recovered

Table 9.8: Definition of LK711 Diagnosis Information

9.2.7 Parameter Specifications

The controller can only read and write the I/O information regularly after it entered data exchange mode. Therefore, in order to provide correct parameter information in the initialization process, parameters shall be first set in the PLC hardware configuration of software PowerPro V4.

After adding “LK711 Do 8x10~60VAC 0.5A” in the PROFIBUS-DP link, user can configure the hardware parameters of LK711.The configurable hardware parameters of a slave station module include communication parameter and user parameters. The specifications of each are as follows:

Communication Parameters

- Supporting PROFIBUS-DP slave station protocol, LK711 completes data exchanges and diagnosis information reporting with the controller and other DP master stations. The slave station adopts a unique communication address,

which is determined by the backplane number and the slot number of the LK711 module. In the configuration, the correct communication address of the slave station shall be filled in the "DP parameters" field. *Refer to Chapter 2: Backplanes for details of communication address assignment.* As shown in Figure 9.20, other parameters in this dialogue box normally need no modifications.

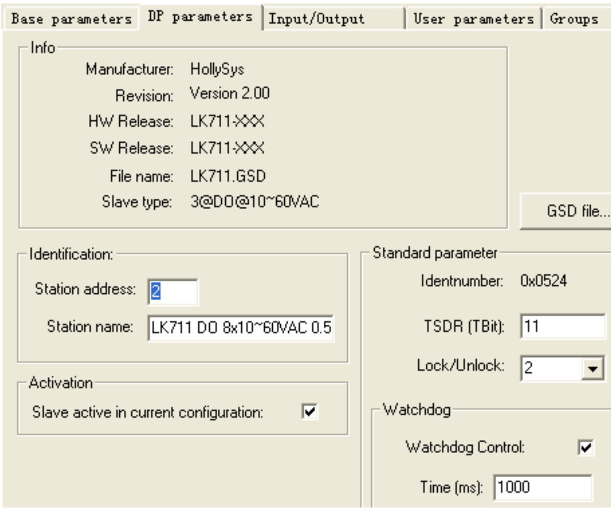


Figure 9.20: Setting of LK711 Communication Parameters

User Parameters

- User parameters are used to configure the module's operating mode. They are written into the controller during the download of user program and will not be read in every scanning circle. Each parameter has a default value that can be changed according to requirements of the project. User parameters do not support online modification; therefore they can only be effective after the full download.
- LK711 has totally 4 bytes of user parameters, including those for program mode output configuration and fault mode output configuration and that to enable power loss detection. The definition of parameters is shown in Table 9.9.

Parameter Name	Parameter Definition	Value Options	Default Value
Program Mode Output	Setting of program mode output	0: Hold Last State 1: Outputs program mode state	0
Fault Mode Output	Setting of fault mode output	0: Hold Last State 1: Outputs fault mode state	0
Group1 Field Power Loss Detec.	Enable channel power loss detection of Group 1	0=Disable, disabled; 1: Enable, enabled.	1
Group2 Field Power Loss Detec.	Enable channel power loss detection of Group 2		
Group3 Field Power Loss Detec.	Enable channel power loss detection of Group 3		
Group4 Field Power Loss Detec.	Enable channel power loss detection of Group 4		
CH1 Program Mode State	Program Mode State of Channel 1	0: OFF, open 1: ON, close	0
CH2 Program Mode State	Program Mode State of Channel 2		
CH3 Program Mode State	Program Mode State of Channel 3		
CH4 Program Mode State	Program Mode State of Channel 4		
CH5 Program Mode State	Program Mode State of Channel 5		
CH6 Program Mode State	Program Mode State of Channel 6		
CH7 Program Mode State	Program Mode State of Channel 7		
CH8 Program Mode State	Program Mode State of Channel 8		
CH1 Fault Mode State	Fault Mode State of Channel 1	0: OFF, open 1: ON, close	0
CH2 Fault Mode State	Fault Mode State of Channel 2		
CH3 Fault Mode State	Fault Mode State of Channel 3		
CH4 Fault Mode State	Fault Mode State of Channel 4		
CH5 Fault Mode State	Fault Mode State of Channel 5		

CH6 Fault Mode State	Fault Mode State of Channel 6		
CH7 Fault Mode State	Fault Mode State of Channel 7		
CH8 Fault Mode State	Fault Mode State of Channel 8		

Table 9.9: List of LK711 User Parameters

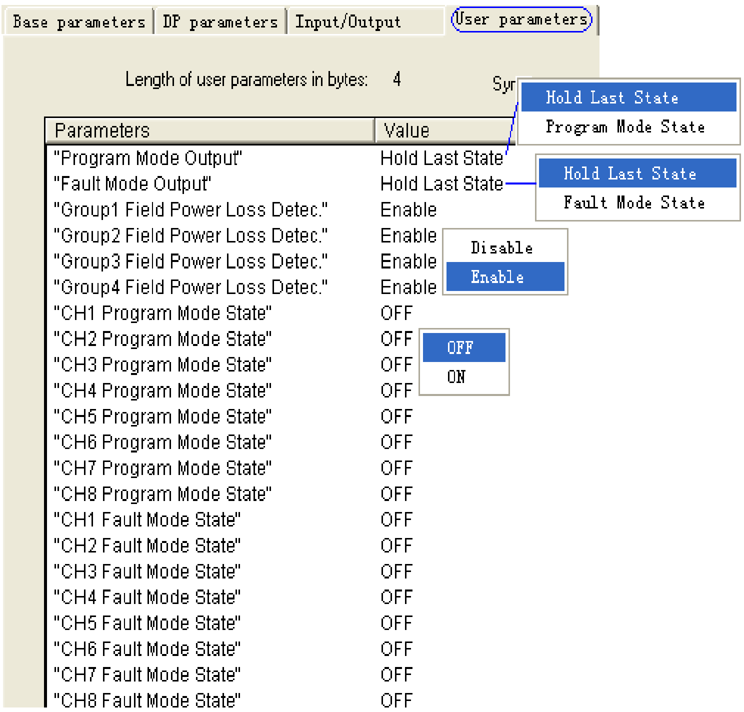


Figure 9.21: Setting of LK711 User Parameters

Specifications of Data Area

- Occupying 1 byte with each bit corresponding to a channel, output data is the 8 channel close or open commands sent to LK711 module by the controller. Input data are the channel readback data reported by LK711 that occupy 1 byte with each bit corresponding to the status readback of a channel.
- The channel readback data of LK711 can be utilized in user programming or channel failure diagnosis.

Area Definition	Data Definition	Value Range
Output Data (%QB)	Control commands of channel output, Bit7~Bit0 corresponding to Channel 8 ~ Channel 1: 1=close 0=open	0x00~0xFF
Readback data (%IB)	Readback of channel control commands, Bit7~Bit0 corresponding to Channel 8 ~ Channel 1: 1=close 0=open	0x00~0xFF

Table 9.10: List of LK711 Input/Output Data

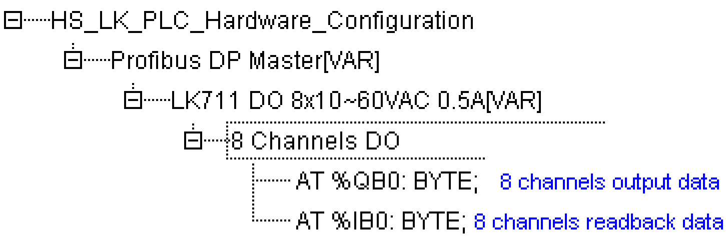


Figure 9.22: LK711 Input/Output Data

9.2.8 Module Installation and Un-installation

Refer to chapter 1 on "Module Insertion Mechanical keys" and "Module Insertion and Removable" for more details.

9.2.9 Technical Specification

LK711 8-Channel 10~60VAC Digital Output Module	
System Power Supply	
Working Voltage	24VDC (-15% ~ 20%)
Backplane Current	60mA max@24V DC
Output Channel	
Number of Channels	8
Number of Groups	4, 2 channels a group with inter-group isolation
Output Switch	TRIAC
Rated output voltage	24V AC
Output Voltage Range	10VAC~60VAC,47~63Hz
Rated output current Each point Each group Each module	 0.5A@60℃ 1A@60℃ 4A@60℃
Inrush current of each point	10A, lasing 50ms, period 2s@60℃
Minimum load current	10mA / point
Maximum On-state Voltage Drop	1.5Vpeak@load current 0.5A 5Vpeak@load current 50mA
Maximum OFF-state Current Leak	3mA / point
Output Delay Time OFF→ON ON→OFF	 8.3ms@60Hz,10ms@50Hz 8.3ms@60Hz,10ms@50Hz
Configurable fault mode output state of each point	Hold Last State (default); ON of OFF
Configurable program mode output state of each point	Hold Last State (default); ON of OFF
Over-Current Protection	1 fast fuse of each group with a rated current of 3A
Reverse Protection	None. In case of wrong wiring, module may be damaged.
Isolation Voltage Group to group Field to System	 500V AC 1min Testing, Current Leak < 5mA 500V AC 1min Testing, Current Leak < 5mA
Failure Diagnosis and Hot Swap	
Power loss detection	Field Power Loss detection of channels
Hot Swap	Support
Communication Bus	
Protocol	PROFIBUS-DP Slave Station, in accordance with IEC61158-3/EN50170 standards
Baud Rate	Baud Rate Options: 1.5Mbps, 500Kbps, 187.5Kbps, 93.75Kbps, 45.45Kbps, 31.25Kbps, 19.2Kbps, 9.6Kbps
Media	Communication bus is connected to the backplane through euro connector, hot redundant communication media
Physical Features	
Mechanic Keys to Prevent Incorrect Insertion	E1
Installation Location	LK local backplane or expansion backplane
Dimension	Width × Height × Depth = 35mm×100mm×100mm
Casing Protection Level	IEC60529 IP20
Weight	200g
Working Environment	
Working temperature	0~60°C
Storage Temperature	-40~70°C
Relative humidity	5%~95%, no condensate

Table 9.11: Technical Specification of LK711 Module

9.2.10 Appendix 1: Fuse Replacement

The fuse is located on the printed circuit board inside LK711. There is one fuse for each group, and 4 in total, as shown in Figure 9.24. When the fuse needs to be changed, the top cover of LK711 needs to be removed and the circuit board should be taken out.

There is a pair of hooks on both the upper and lower ends of the top cover of the module, which are hooked into the corresponding slots in the module casing. When the module needs to be removed, first remove the hook from the slots using a screw driver, remove the top cover, and pull out the printed circuit board, as shown in Figure 9.23.

Note: when removing the circuit board, replacing the fuse and putting back the circuit board, it is strictly prohibited to touch the chips and the surface of the circuit board, so as to prevent damages to the circuit by static. If possible, use anti-static gloves or other anti-static measures. Otherwise, proceed with caution and only hold the edge of the circuit board when operating on it.

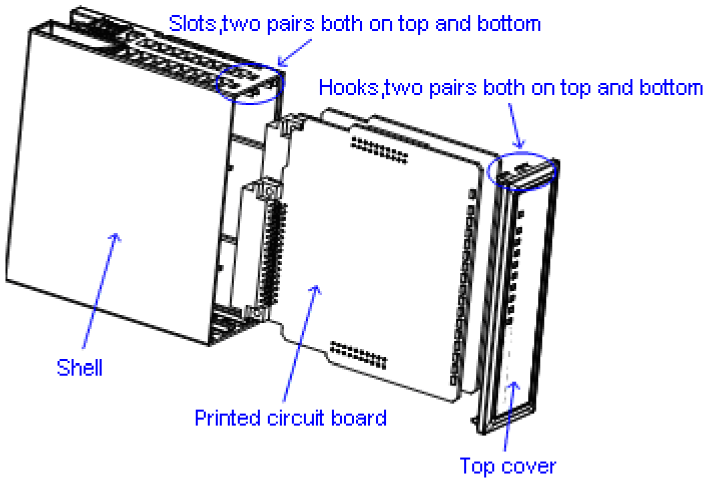


Figure 9.23: Remove the top cover to pull out the printed circuit board

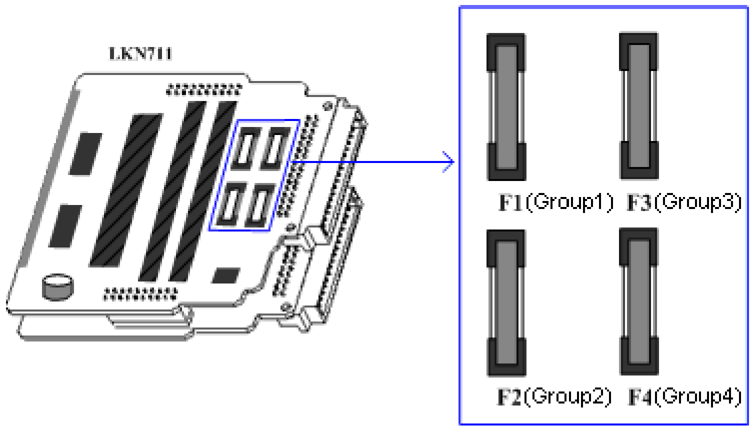


Figure 9.24: Fuse on LK711 Circuit Board

9.3 LK712 8-CHANNEL 74~265VAC DO MODULE

9.3.1 Features

- 8 channels of TRIAC outputs
- Field power voltage range: 74~265VAC
- Support ProfiBus-DP Slave Station Protocol
- Fault Mode Output
- Program mode output
- Output readback;
- Field Power Loss Detection
- Over-current/over-voltage protection
- Group output, inter-group isolation
- System-to-Field Isolation
- Supports hot swap

9.3.2 Operation Principles

The controller writes the output data into the memory of LK712 through ProfiBus-DP bus. The output data controls the open and close commands of the driver circuitry. When the level of the control signal is high, the TRIAC is closed, and the field driver is loaded to achieve digital output.

With a voltage range of 74~265VAC, the external 110/230VAC field power supply shall be electrically isolated from the internal 24VDC system power supply of LK712.

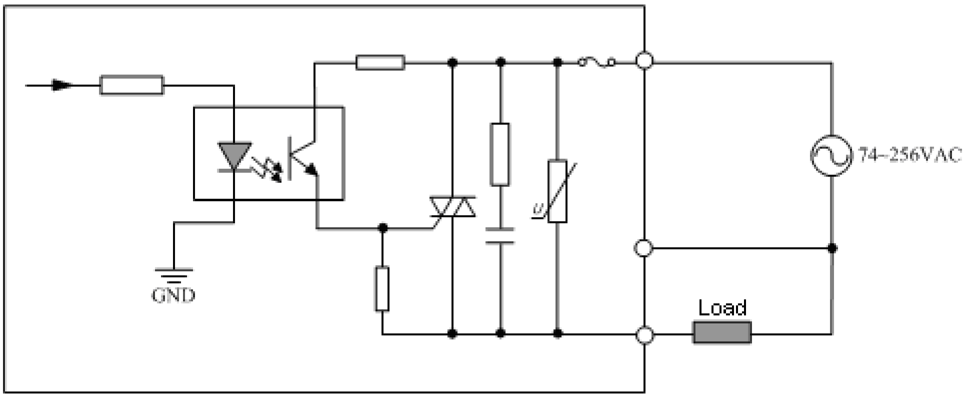


Figure 9.25: LK 712 Channel Interface Circuit

9.3.3 Indicators Definition

RUN indicator (Green)	On	Communication is established, module in normal operation
	Flash	Communication is not established or communication error
	Off	Power Off or Module Failure
01~08 channel indicators (yellow)	On	The channel is closed
	Off	Channel is opened

Table 9.12: Definitions of LK712 indicators

Specifications of RUN green light are as follows:

- After the power is on, the module waits for initialization data while the green light flashes with a frequency of 4 times per second.
- After the initialization is completed, the green light is constantly on to indicate the module in normal operation; if any error occurs in the initialization, then the communication is not established and the green light keeps flashing. Then, setting s of communication parameters (slave station address, etc) shall be checked.
- Green light is constantly on in normal communications; green light flashes when communication breaks; green light returns to constant on when communication re-established.
- Wiring Specifications
- LK712 output contact points are dry contacts; hence it requires field power supply to drive optical coupler output. LK712 modules are installed on LK backplanes, which support two types of wrings: terminal wiring and prefabricated cable wring.

9.3.4 Wiring Specification

Wiring to Backplane Terminals

- As shown in Table 9.13, the 8 channels of outputs of LK712 are divided into 4 groups with 2 channels in each group, and each group are powered by a separate field AC power supply. Isolation voltage of the inter-group isolation is 1000VAC.

Channels No.		Terminal Number
Group 1	Channel 1	01
	Channel 2	02
	Field Power Supply 1	03/04
Group 2	Channel 3	05
	Channel 4	06
	Field Power Supply 2	07/08
Group 3	Channel 5	09
	Channel 6	10
	Field Power Supply 3	11/12
Group 4	Channel 7	13
	Channel 8	14
	Field Power Supply 4	15/16

Table 9.13: Definitions of LK712 Backplane Wiring Terminals

- LK712 module is wired through the correspondence terminals under the local backplane installation slot. The relationship between each channel and terminal is shown in Figure 9.26. One ends of the 8 channel loads connect to the wiring terminals of their correspondence channels while the other ends connect to each field power supply.

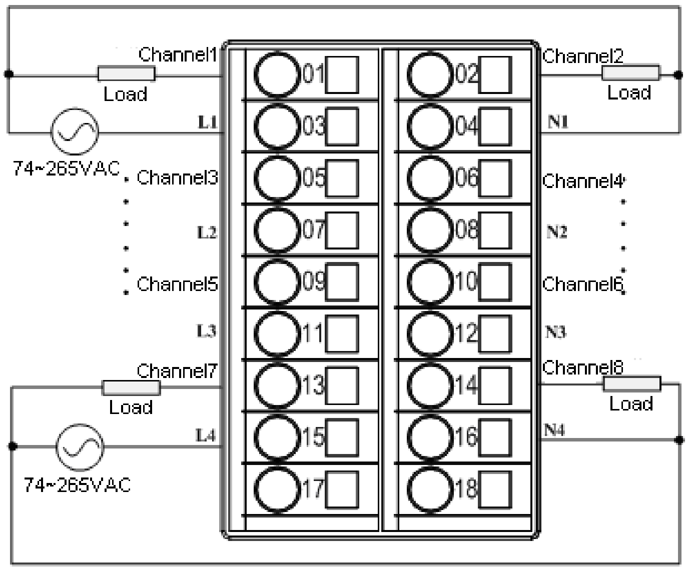


Figure 9.26: Wiring of LK712 Backplane Terminals

In the wiring, the following shall be noted:

- Each group employs a field power supply for the electric isolation between groups.
- Terminals "1", "2", "5", "6", "9", "10", "13", "14" are the digital output terminals of channel 1~8.
- Terminal "3", "7", "11" and "15" are the field power supply input ends of each group that normally connect by live line. They are also the module's internal common ends of each group of outputs.
- Terminals "4", "8", "12", "16" are the return terminals of field power supply that normally connect by ground line. They are also the common ends of the 2 channel loads in every group that can be utilized for field power loss detection.
- Terminal "17" and "18" shall not be connected in the wiring.
- A single terminal shall not be connected to many wires, therefore multiple-point connection can be established through bus bar or transferring terminal board.

Wiring to Terminal Modules

Please refer to the information found on Chapter 12: Terminal Module.

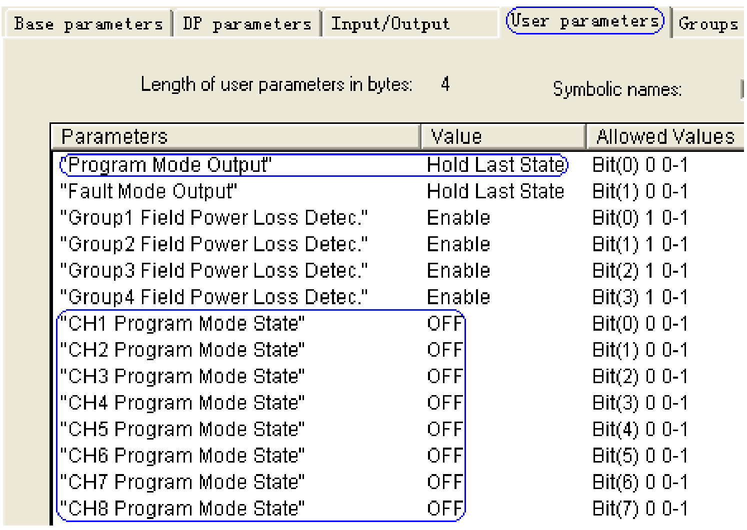
9.3.5 Function Specifications

Enable Output

- After the output module is power on, if it does not receive any output command from the controller, it will keep the initial mode and does no output. The output of an initial status module is disabled. In this case, the module will keep this initial status even it enters program mode or fault mode.
- After the operation of user programs, the controller sends output command to the output module through PROFIBUS-DP bus. Output module receives command and outputs data. The output of a slave module is enabled once the module outputs an command sent by the controller. When the module output is enabled, in case the module enters programming mode or failure mode, it will output states of program mode or fault mode.
- In short, whether the module output is enabled will affect its output status under fault mode and program mode.
- If the module is hot-swamped or turned on again after power loss after its output is enabled, it will return back to the initial status and the output is disabled again. The output will be enabled again once the module receives another output command from the controller.
- After a full-download, the user program in the controller stops operation and the slave module enters program mode automatically. In this case, if the module output is enabled before the download, it will output the program mode state; if the module output is disabled before the download, it will keep the initial status.
- After the full-download, the user program operation can be executed through the following two methods:
- Turn the key switch on controller front-panel to “RUN”.
- Turn the key switch on controller front-panel to “REM” and execute “Run” command in the programming software.

Program Mode

- Program mode is the operating mode of the controller to modify, edit and download user programs. In program mode, user programs are halted and cannot be restarted through configuration software. Not under control, digital output module retains output (Hold Last State) or outputs a state (ON or OFF) preset in the configuration, known as the Program Mode State.
- Controller can make the slave station enter or exit program mode through the following methods:
- Turn the key switch to “PRG” to force all modules into program mode. Then, operation of user program halts, module outputs program mode state.
- Turn the key switch to “RUN”, module exits program mode and controller runs the user program.
- Please note that if the module has never been output enabled, it does not output programming mode value even it enters program mode.
- After the full-download of user program, output module automatically enters program mode no matter whether the controller key switch is located at “PRG”. If the module has never output any data before the download (e.g. output is not enabled), it will retain the initial status and does not output. If the module output has been enabled before the download, module outputs program mode state.
- Under program mode, whether the module retains output (Hold Last State) or outputs program mode state is configured by user parameter “Program Mode Output”, whose default value is “Hold Last State”. Program mode state is configured by user parameter “Program Mode State”, default output of which is OFF (open). Modifications will only be effective after the full download. Special notes shall be taken that: after the full down and before the operation, the module is under programming mode and outputs previous programming mode value. The new state will only replace the previous one after the operation of user program.

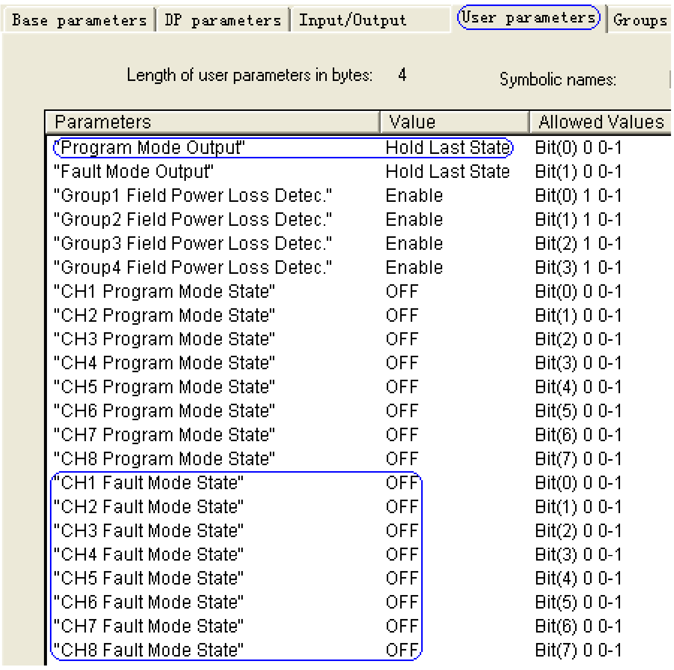


Parameters	Value	Allowed Values
"Program Mode Output"	Hold Last State	Bit(0) 0 0-1
"Fault Mode Output"	Hold Last State	Bit(1) 0 0-1
"Group1 Field Power Loss Detec."	Enable	Bit(0) 1 0-1
"Group2 Field Power Loss Detec."	Enable	Bit(1) 1 0-1
"Group3 Field Power Loss Detec."	Enable	Bit(2) 1 0-1
"Group4 Field Power Loss Detec."	Enable	Bit(3) 1 0-1
"CH1 Program Mode State"	OFF	Bit(0) 0 0-1
"CH2 Program Mode State"	OFF	Bit(1) 0 0-1
"CH3 Program Mode State"	OFF	Bit(2) 0 0-1
"CH4 Program Mode State"	OFF	Bit(3) 0 0-1
"CH5 Program Mode State"	OFF	Bit(4) 0 0-1
"CH6 Program Mode State"	OFF	Bit(5) 0 0-1
"CH7 Program Mode State"	OFF	Bit(6) 0 0-1
"CH8 Program Mode State"	OFF	Bit(7) 0 0-1

Figure 9.27: LK712 Output Setting under Program Mode

Communication Failure

- When communication failure occurs, the communication between controller and output module breaks and the "RUN" light flashes. The module may be in one of the following states in communication failure:
- After power on, module cannot establish communication with the controller, then the module will retain the initial status and its output is not enabled.
- Module in operation when communication failure (offline) occurs: module retains output (Hold Last State) or outputs a state (ON or OFF) preset in the configuration, known as the Fault Mode State. Whether the module retains output or outputs fault mode state can be configured in software.
- Module in program mode when communication failure occurs: module enters fault mode and outputs fault mode state. When failure recovered, module returns to program mode automatically and outputs program mode state again with the "RUN" light constantly on.
- If the module output has not been enabled, the module does not output fault mode state even if any communication failure occurs.
- Under fault mode, whether the module retains output or outputs fault mode value is configured by user parameter "Fault Mode Output", default value of which is "Hold Last Value". Fault mode state is configured by user parameter "Fault Mode State", default output of which is OFF (open). Parameters of each channel are configured separately without interfere to others.



Base parameters | DP parameters | Input/Output | User parameters | Groups

Length of user parameters in bytes: 4   Symbolic names:

Parameters	Value	Allowed Values
"Program Mode Output"	Hold Last State	Bit(0) 0 0-1
"Fault Mode Output"	Hold Last State	Bit(1) 0 0-1
"Group1 Field Power Loss Detec."	Enable	Bit(0) 1 0-1
"Group2 Field Power Loss Detec."	Enable	Bit(1) 1 0-1
"Group3 Field Power Loss Detec."	Enable	Bit(2) 1 0-1
"Group4 Field Power Loss Detec."	Enable	Bit(3) 1 0-1
"CH1 Program Mode State"	OFF	Bit(0) 0 0-1
"CH2 Program Mode State"	OFF	Bit(1) 0 0-1
"CH3 Program Mode State"	OFF	Bit(2) 0 0-1
"CH4 Program Mode State"	OFF	Bit(3) 0 0-1
"CH5 Program Mode State"	OFF	Bit(4) 0 0-1
"CH6 Program Mode State"	OFF	Bit(5) 0 0-1
"CH7 Program Mode State"	OFF	Bit(6) 0 0-1
"CH8 Program Mode State"	OFF	Bit(7) 0 0-1
"CH1 Fault Mode State"	OFF	Bit(0) 0 0-1
"CH2 Fault Mode State"	OFF	Bit(1) 0 0-1
"CH3 Fault Mode State"	OFF	Bit(2) 0 0-1
"CH4 Fault Mode State"	OFF	Bit(3) 0 0-1
"CH5 Fault Mode State"	OFF	Bit(4) 0 0-1
"CH6 Fault Mode State"	OFF	Bit(5) 0 0-1
"CH7 Fault Mode State"	OFF	Bit(6) 0 0-1
"CH8 Fault Mode State"	OFF	Bit(7) 0 0-1

Figure 9.28: LK712 Fault Mode State Setting

Over-Current Protection

- The output circuit of the module connects a fast fuse (rated current 3A) in series to protect the module components in case of power surge, such as, output short circuit. The outputs of each group share 1 fuse.

Refer to Appendix 1: Fuse Replacement in page 314 for the fuse replacement.

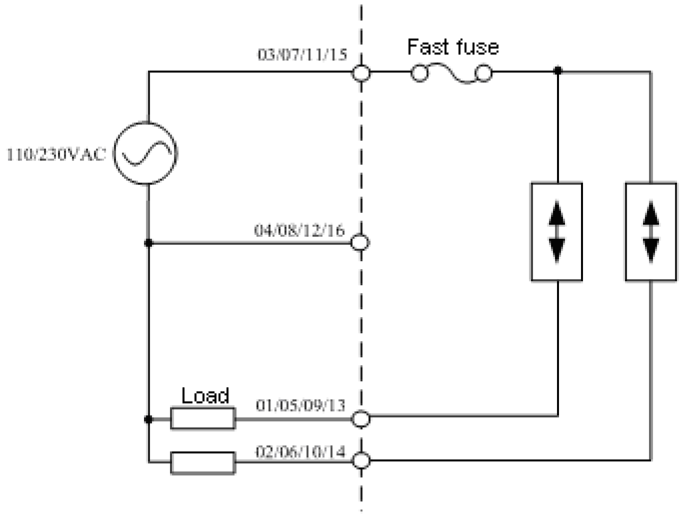


Figure 9.29: Over-Current Protection of LK712 Channels

9.3.6 Diagnosis Specifications

PowerPro V4 configuration software adopts external diagnosis library to check and acquire all kinds of diagnosis information, such as whether the module and its channels are operating normally, whether the field power supplying smoothly and whether the module parameters are set correctly.

For the DP slave station modules, the DP slave station expansion diagnosis function block (HS_DPSlaveALarm) shall be called to check the DP module at any address (DP_Addr) on the PROFIBUS-DP link, as shown in Figure 9.30.

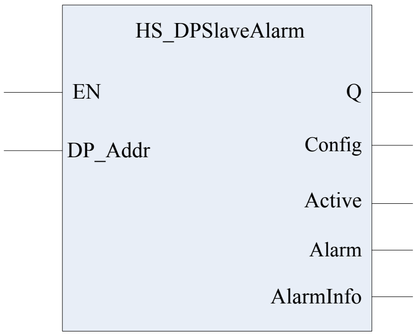


Figure 9.30: Expansion Diagnosis Function Block for DP Slave Station

For detailed usage of DP Expansion Diagnosis Function Block, please refer to LK Large Scale PLC Instruction Manual. Users shall note that the Diagnosis library is an external library that shall be first installed in the Library Manager before use.

The diagnosis information of DP slave station modules can be classified to 3 categories: device diagnosis, identifier diagnosis and channel diagnosis. All diagnosis data exist in the form of block structure.

- Device Diagnosis: records of the overall diagnosis information of the module, such as, power loss of field power supply.
- Identifier Diagnosis: records of whether the module has diagnosis information.
- Channel Diagnosis: records of the channel level diagnosis information, such as disconnection and rang exceeding.

For details of the DP parameters, please refer to LK Large Scale Programmable Logic Controller Hardware Manual.

Field Power Loss Detection

- LK712 provides field power loss detection. Each group employs a field power supply. Whether to enable the field power loss detection of a group is selected through user parameter “FieldPowerLossDetection”, the default value of which is “Enable".
- The power loss detection of each group can be enabled separately without inference to each other. Parameter changes can only be effective after a full download.

- Each group of output has two wiring terminals connect to the field power supply. LK711 carries out power loss detection by checking the changes of input voltage between these two terminals. In case of any failure, the failure status will be reported to the controller as the diagnosis data.

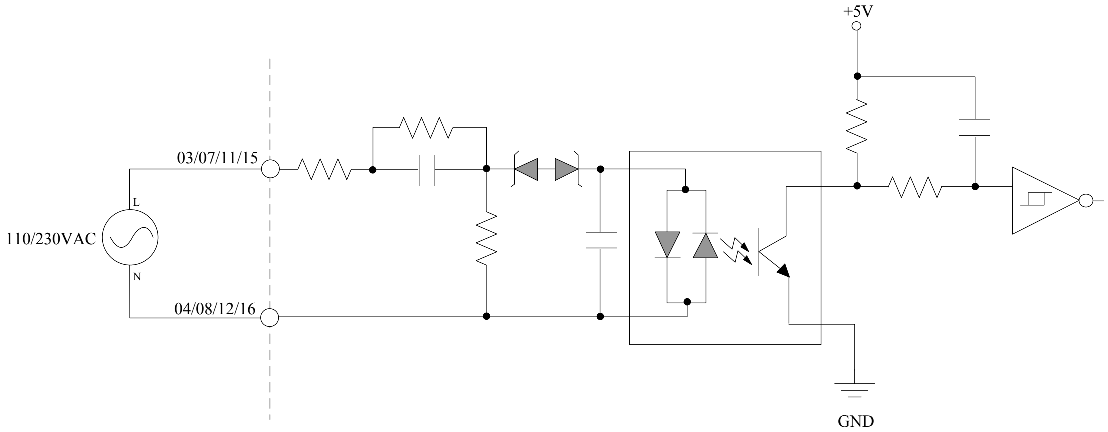


Figure 9.31: Field Power Loss Detection Circuit of LK712

- LK712 employs 4 independent external field power supplies and it carries out the power loss diagnosis to these 4 field power supplies at the same time. To determine which one of the field power supplies get loss, device diagnosis is not enough. Therefore further channel diagnoses shall be executed. When the power of a group is lost, the diagnosis shows that failure occurs in the 2 output channels of the group and power loss in the channel.
- When the field 110/230VAC power supply of a group is lost (line-break or power supply output voltage <40VAC), LK712 device diagnosis data area generates diagnosis byte "0x05" (Bit2 of device diagnosis byte =1 and Bit0=1). At the same time, diagnosis areas of the two power loss channels generate diagnosis data "17" (failure type value 17 indicates field power loss of the channel). Module then reports the diagnosis data to the controller in the next scan period.
- When the field 110/230VAC power supply of a group is recovered (output voltage in the range of 74~265VAC), LK712 device diagnosis area generates a new diagnosis byte "0x00" while the two channel diagnosis areas generate new diagnosis data "0" (failure type value 0 indicates that channel failure is recovered). Module then reports the diagnosis data to the controller in the next scan period.
- LK712 module will only report the diagnosis data once respectively when failure occurs and is recovered.

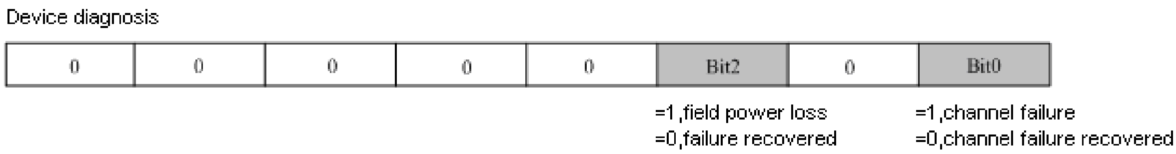


Figure 9.32: Device Diagnosis Byte of LK712 Module

- After the DP slave station expansion diagnosis function block (HS_DPSlaveAlarm) is called, the device diagnosis and channel diagnosis data reported by LK712 will be stored in the corresponding fields of the output parameter "AlarmInfo", as shown in Table 9.14.

Diagnosis Information		Value	Definition
Device Diagnosis	ALarmInfo.DevDiag.Data[1]	0x05	Field Power Loss
		0x00	Failure Recovered
Channel Diagnosis	ChDiag.Module.Channel.ChNo	1~8	Channel Number of the Failure
	ChDiag.Module.Channel.Error	17	Field Power Loss of the channel
		0	Channel Failure Recovered

Table 9.14: Definition of LK712 Diagnosis Information

9.3.7 Parameter Specifications

The controller can only read and write the I/O information regularly after it entered data exchange mode. Therefore, in order to provide correct parameter information in the initialization process, parameters shall be first set in the PLC hardware configuration of software PowerPro V4.

After adding "LK712 Do 8x74~265VAC 1A" in the PROFIBUS-DP link, user can configure the hardware parameters of LK712.The configurable hardware parameters of a slave station module include communication parameter and user parameters. The specifications of each are as follows:

Communication Parameters

- Supporting PROFIBUS-DP slave station protocol, LK712 completes data exchanges and diagnosis information reporting with the controller and other DP master stations. Communication address is the DP module node number for the communication with the controller. In the PROFIBUS-DP bus link, a unique communication address is assigned to each module. If there is any error of the communication address, the slave station module will not be able to establish communication with the controller.
- Installed on the LK backplane, the unique communication address of LK712 module is determined only by its installation location. *Refer to Chapter 2: Backplanes for the details of communication address assignment.*
- After a DP module is added, it will have a default "station address", as shown in Figure 9.33. This address is not the correct communication address of the module but an address automatically assigned to the module by the software according to the adding order.
- The correct communication address of each DP module shall be re-assigned in parameter "station address". Other parameters keep their default value and do not need modification.
- If modules have been added or deleted in the configuration software, or the slot number of module on the backplane has been changed, the communication address in "station address" shall be checked to ensure the accuracy.

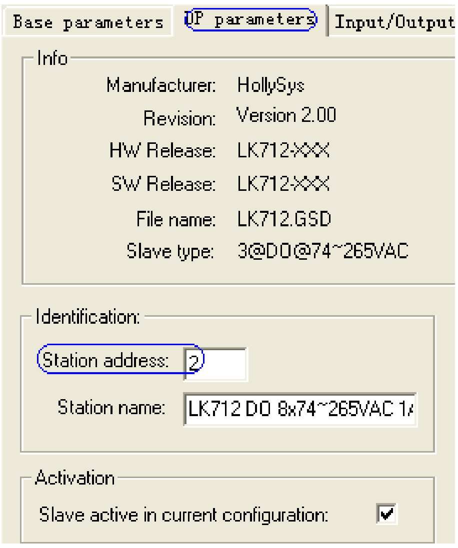


Figure 9.33: Communication Address of LK712

User Parameters

- User parameters are used to configure the module's operating mode. They are written into the controller during the download of user program and will not be read in every scanning circle. Each parameter has a default value that can be changed according to requirements of the project. User parameters do not support online modification; therefore they can only be effective after the full download.
- LK712 has totally 4 bytes of user parameters, including those for program mode output configuration and fault mode output configuration and that to enable power loss detection. The definition of parameters is shown in Table 9.15.

Parameter Name	Parameter Definition	Value Options	Default Value
Program Mode Output	Setting of Program mode output	0: Hold Last State 1: Outputs program mode state	0
Fault Mode Output	Setting of fault mode output	0: Hold Last State 1: Outputs fault mode state	0
Group1 Field Power Loss Detec.	Enable channel power loss detection of Group 1	0=Disable, disabled; 1: Enable, enabled.	1
Group2 Field Power Loss Detec.	Enable channel power loss detection of Group 2		
Group3 Field Power Loss Detec.	Enable channel power loss detection of Group 3		
Group4 Field Power Loss Detec.	Enable channel power loss detection of Group 4		
CH1 Program Mode State	Program Mode State of Channel 1	0: OFF, open 1: ON, close	0
CH2 Program Mode State	Program Mode State of Channel 2		
CH3 Program Mode State	Program Mode State of Channel 3		
CH4 Program Mode State	Program Mode State of Channel 4		
CH5 Program Mode State	Program Mode State of Channel 5		
CH6 Program Mode State	Program Mode State of Channel 6		
CH7 Program Mode State	Program Mode State of Channel 7		
CH8 Program Mode State	Program Mode State of Channel 8		
CH1 Fault Mode State	Fault Mode State of Channel 1	0: OFF, open 1: ON, close	0
CH2 Fault Mode State	Fault Mode State of Channel 2		
CH3 Fault Mode State	Fault Mode State of Channel 3		
CH4 Fault Mode State	Fault Mode State of Channel 4		
CH5 Fault Mode State	Fault Mode State of Channel 5		
CH6 Fault Mode State	Fault Mode State of Channel 6		
CH7 Fault Mode State	Fault Mode State of Channel 7		
CH8 Fault Mode State	Fault Mode State of Channel 8		

Table 9.15: List of LK712 User Parameters

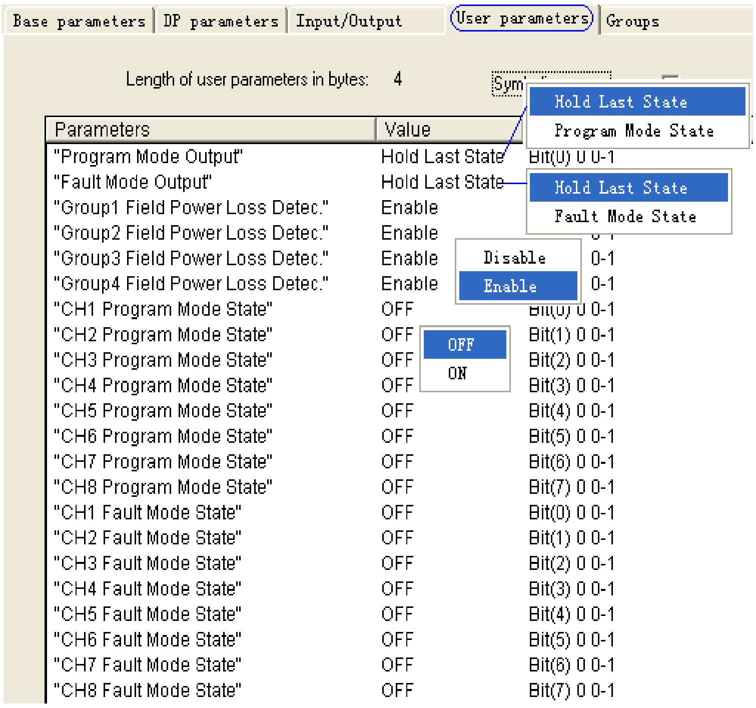


Figure 9.34: LK712 User Parameter Interface

Specifications of Data Area

- Occupying 1 byte with each bit corresponding to a channel, output data in the data area are the 8 channel close or open commands sent to LK712 module by the controller. Input data are the current status of 8 channels reported by LK712 that occupy 1 byte with each bit corresponding to a channel.
- The channel readback data of LK712 can be utilized in user programming or channel failure diagnosis.

Area Definition	Data Definition	Value Range
Output Data (%QB)	Channel control commands output, Bit7~Bit0 corresponding to Channel 8 ~ Channel 1: 1=close 0=open	0x00~0xFF
Input Data(%IB)	Readback of channel control commands, Bit7~Bit0 corresponding to Channel 8 ~ Channel 1: 1=close 0=open	0x00~0xFF

Table 9.16: Definition of LK712 Data Area

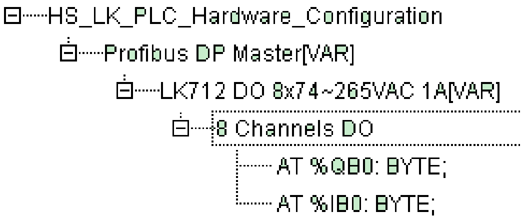


Figure 9.35: LK712 Input/Output Data

9.3.8 Module Installation and Un-installation

Refer to chapter 1 on "Module Insertion Mechanical keys" and "Module Insertion and Removable" for more details.

9.3.9 Technical Specification

LK712 8-Channel 74~265VAC Digital Output Module	
System Power Supply	
Working Voltage	24VDC (-15% ~ 20%)
Backplane Current	60mA max@24V DC
Output Channel	
Number of Channels	8
Number of Groups	4
Output Switch	TRIAC
Rated output voltage	110/230VAC
Output Voltage Range	74VAC~265VAC, 47~63Hz
Rated output current Each point Each group Each module	 1A@60℃ 1.6A@60℃ 6.4A@60℃
Inrush current of each point	10A, lasing 50ms, period 2s@60℃
Minimum load current	10mA / point
Maximum On-state Voltage Drop	1.5Vpeak@load current 0.5A 5Vpeak@load current 50mA
Maximum OFF-state Current Leak	3mA / point
Output Delay Time OFF→ON ON→OFF	 8.3ms@60Hz, 10ms@50Hz 8.3ms@60Hz, 10ms@50Hz
Configurable fault mode output state of each point	Hold Last State (default); ON of OFF
Configurable program mode output state of each point	Hold Last State (default); ON of OFF
Over-Current Protection	Fuse protection of each group
Over-Voltage Protection	Voltage-sensitive resistance protection of each channel
Isolation Voltage Group to group Field to System	 1000VAC@1min, Current Leak 5mA 1000VAC@1min, Current Leak 5mA
Failure Diagnosis and Hot Swap	
Field Power Loss Detection	Field power loss: device diagnosis byte=0x05, channel diagnosis byte =17; Field power loss recovered: device diagnosis byte =0x00, channel diagnosis byte=0
Hot Swap	Support
Communication Bus	
Protocol	PROFIBUS-DP Slave Station, in accordance with IEC61158-3/EN50170 standards
Baud Rate	Baud Rate Options: 1.5Mbps, 500Kbps, 187.5Kbps, 93.75Kbps, 45.45Kbps, 31.25Kbps, 19.2Kbps, 9.6Kbps
Media	Communication bus is connected to the backplane through euro connector, hot redundant communication media
Physical Features	
Mechanic Keys to Prevent Incorrect Insertion	B4
Installation method	LK local backplane or expansion backplane, installation slot
Dimension	Width × Height × Depth = 35mm×100mm×100mm
Casing Protection Level	IEC60529 IP20
Weight	180g
Working Environment	
Working temperature	0~60°C
Working Relative Humidity	10%~95%, no condensate
Storage Temperature	-40~70°C
Storage Temperature	10%~95%, no condensate

Table 9.17: Technical Specification of LK712 Module

9.3.10 Appendix 1: Fuse Replacement

The fuse is located on the printed circuit board inside LK712. There is one fuse for each group (2 channels), and 4 in total, as shown in Figure 9.37. When the fuse needs to be changed, the top cover of LK712 needs to be removed and the circuit board should be taken out.

There is a pair of hooks on both the upper and lower ends of the top cover of the module, which are hooked into the corresponding slots in the module casing. When the module needs to be removed, first remove the hook from the slots using a screw driver, remove the top cover, and pull out the printed circuit board, as shown in Figure 9.36.

Note: when removing the circuit board, replacing the fuse and putting back the circuit board, it is strictly prohibited to touch the chips and the surface of the circuit board, so as to prevent damages to the circuit by static. If possible, use anti-static gloves or other anti-static measures. Otherwise, proceed with caution and only hold the edge of the circuit board when operating on it.

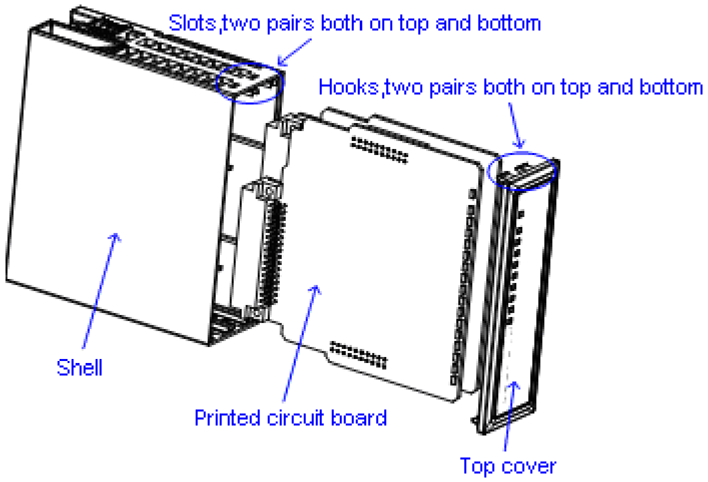


Figure 9.36: Remove the top cover to pull out the printed circuit board

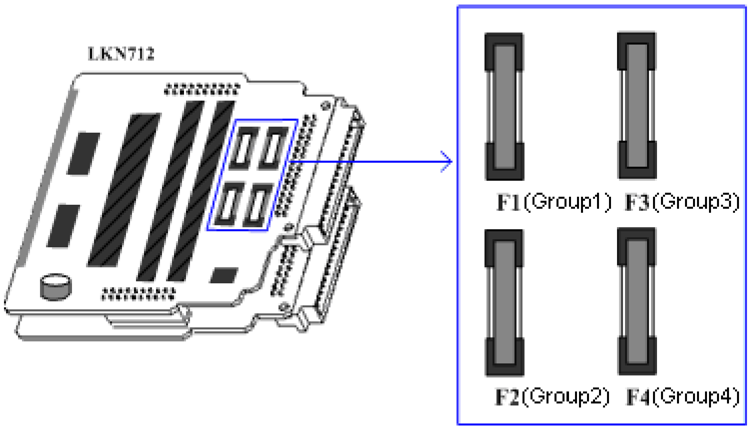


Figure 9.37: Fuse on LK712 Circuit Board

9.4 LK720 8-CHANNEL 10~265VAC/5~125VDC RELAY OUTPUT MODULE

9.4.1 Features

- 8 channels of relay outputs, non source open contact
- DC voltage range: 5~125VDC
- AC Voltage range: 10~256VAC@47~63Hz
- Support ProfiBus-DP Slave Station Protocol
- Fault Mode Safety Output
- Program mode output
- Output readback diagnosis
- Field Power Loss Detection
- Inter-channel isolation
- System-to-Field Isolation
- Supports hot swap

9.4.2 Operation Principles

The controller writes the output data into the memory of LK720 through ProfiBus-DP bus. These data control the drive circuit closing or opening the relay contact to drive the load in the output circuit.

As shown in Figure 9.38, the relay is in a constantly open status.

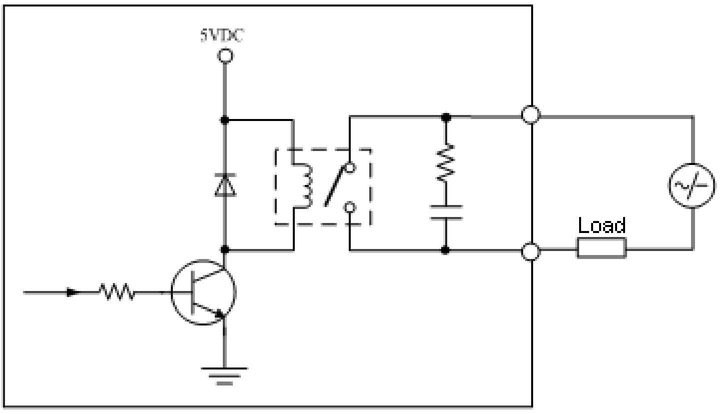


Figure 9.38: LK 720 Channel Interface Circuit

9.4.3 Indicators Definition

RUN indicator (Green)	On	Communication is established, module in normal operation
	Flash	Communication is not established or communication error
	Off	Power off of the module
01~08 channel indicators (yellow)	On	The channel is closed
	Off	Channel is opened

Table 9.18: Definitions of LK720 indicators

Specifications of RUN green light are as follows:

- After the power is on, the module waits for initialization data while the green light flashes with a frequency of 4 times per second.
- After the initialization is completed, the green light is constantly on to indicate the module in normal operation; if any error occurs in the initialization, then the communication is not established and the green light keeps flashing. Then, communication parameter settings shall be checked.
- In normal communications, green light is constantly on; when communication breaks, green light flashes while the module automatically enters fault mode; when communication is re-established, the green light is constantly on again and the module automatically exits fault mode.

9.4.4 Wiring Specifications

LK720 output contact points are dry contacts; hence it requires field power supply to drive optical coupler output. The field power supply can be a 5~125VDC power or a 10~265VAC power, which is selected according to different types of the load.

LK720 module is installed on LK series backplanes that support two types of wirings: terminal wiring and prefabricated cable wring.

Wiring to Backplane Terminals

➢ LK720 module is wired through the correspondence terminals under the local backplane installation slot. The relationship between each channel and terminal is shown in Figure 9.39 and Figure 9.40. The 8 channel outputs can share a field power supply when there is no isolation between channels. They can also connect to separate field power supplies when the channels are isolated from each other.

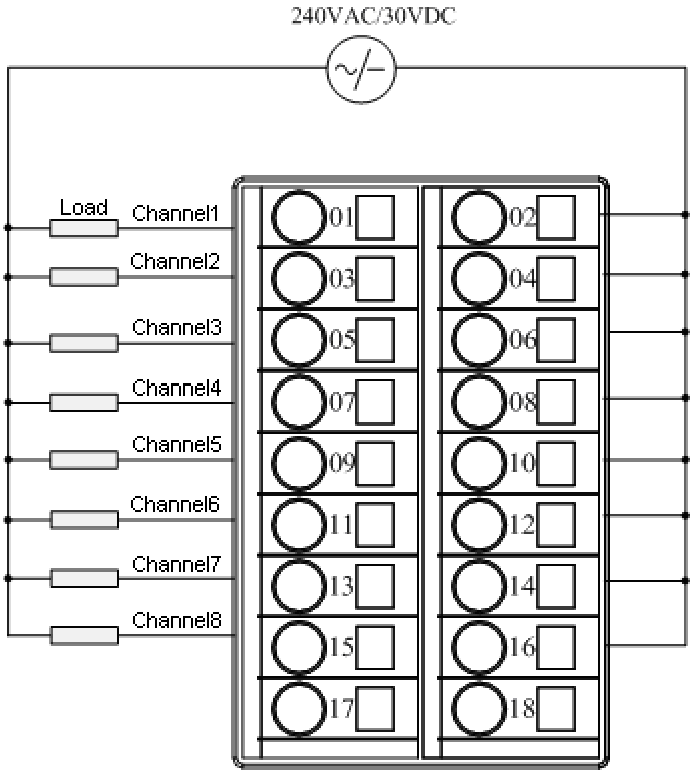


Figure 9.39: Wiring of LK720 Backplane Terminals with Single Power Supply

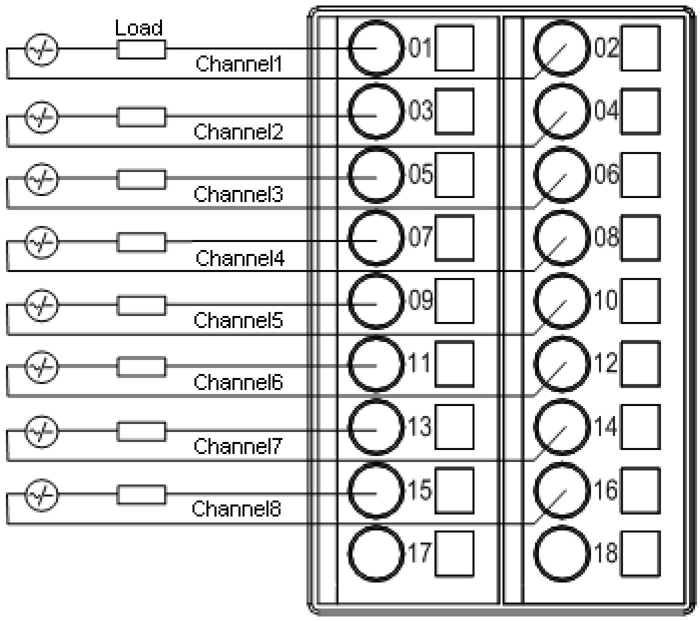


Figure 9.40: Wiring of LK720 Backplane Terminals with Multiple Power Supply

In the wiring, the following shall be noted:

The field power supply can use both DC power and AC power.

➢ Signals of each channel are connected to the wiring terminals through 2 cables without distinguish between positive and negative.

- When module employs single power supply, there is no isolation between channels; when module employs multiple power supplies, there is isolation between channels using different power supplies.
- A single terminal shall not be connected to many wires; therefore multiple-point connection can be established through bus bar or transferring terminal board.
- Terminal "17" and "18" shall not be connected in the wiring.

Wiring to Terminal Modules

Please refer to the information found on Chapter 12: Terminal Module.

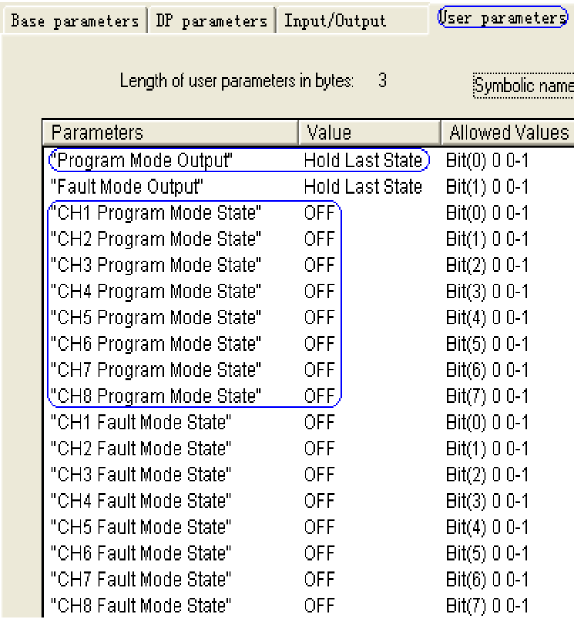
9.4.5 Function Specifications

Enable Output

- After the output module is power on, if it does not receive any output command from the controller, it will keep the initial mode and does no output. The output of an initial mode module is disabled. In this case, the module will keep this initial status even it enters program mode or fault mode.
- After the operation of user programs, the controller sends output command to the output module through PROFIBUS-DP bus. Output module receives command and outputs data. The output of a slave module is enabled once the module outputs an command sent by the controller. When the module output is enabled, in case the module enters programming mode or failure mode, it will output states of program mode or fault mode.
- In short, whether the module output is enabled will affect its output status under fault mode and program mode.
- If the module is hot-swamped or turned on again after power loss after its output is enabled, it will return back to the initial status and the output is disabled again. The output will be enabled again once the module receives another output command from the controller.
- After a full-download, the user program in the controller stops operation and the slave module enters program mode automatically. In this case, if the module output is enabled before the download, it will output the program mode state; if the module output is disabled before the download, it will keep the initial status.
- After the full-download, the user program operation can be executed through the following two methods:
- Turn the key switch on controller front-panel to "RUN".
- Turn the key switch on controller front-panel to "REM" and execute "Run" command in the programming software.

Program Mode

- Program mode is the operating mode of the controller to modify, edit and download user programs. In program mode, user programs are halted and cannot be restarted through configuration software. Not under control, digital output module retains output (Hold Last State) or outputs a state (ON or OFF) preset in the configuration, known as the Program Mode State.
- Controller can make the slave station enter or exit program mode through the following methods:
- Turn the key switch to "PRG" to force all modules into program mode. Then, operation of user program halts, module outputs program mode state.
- Turn the key switch to "RUN", module exits program mode and controller runs the user program.
- Please note that if the module has never been output enabled, it does not output programming mode value even it enters program mode.
- After the full-download of user program, output module automatically enters program mode no matter whether the key switch on the controller is located at "PRG". If the module has never output any data before the download (e.g. output is not enabled), the relay retains the opening status. If the module output has been enabled before the download, module outputs program mode state.
- Under program mode, whether the module retains output (Hold Last State) or outputs program mode state is configured by user parameter "Program Mode Output", whose default value is "Hold Last State". Program mode state is configured by user parameter "Program Mode State", default output of which is OFF (open). Modifications will only be effective after the full download. Special notes shall be taken that: after the full down and before the operation, the module is under program mode and outputs previous program mode state. The new state will only replace the previous one after the operation of user program.



Base parameters | DP parameters | Input/Output | User parameters

Length of user parameters in bytes: 3

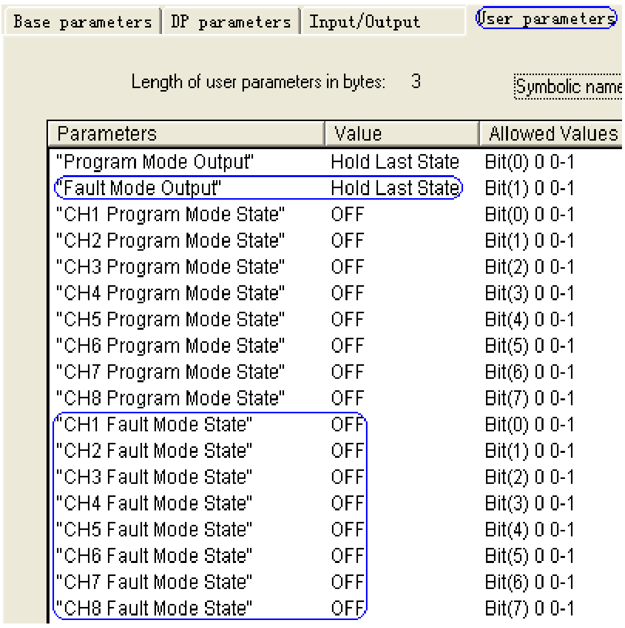
Symbolic name

Parameters	Value	Allowed Values
"Program Mode Output"	Hold Last State	Bit(0) 0 0-1
"Fault Mode Output"	Hold Last State	Bit(1) 0 0-1
"CH1 Program Mode State"	OFF	Bit(0) 0 0-1
"CH2 Program Mode State"	OFF	Bit(1) 0 0-1
"CH3 Program Mode State"	OFF	Bit(2) 0 0-1
"CH4 Program Mode State"	OFF	Bit(3) 0 0-1
"CH5 Program Mode State"	OFF	Bit(4) 0 0-1
"CH6 Program Mode State"	OFF	Bit(5) 0 0-1
"CH7 Program Mode State"	OFF	Bit(6) 0 0-1
"CH8 Program Mode State"	OFF	Bit(7) 0 0-1
"CH1 Fault Mode State"	OFF	Bit(0) 0 0-1
"CH2 Fault Mode State"	OFF	Bit(1) 0 0-1
"CH3 Fault Mode State"	OFF	Bit(2) 0 0-1
"CH4 Fault Mode State"	OFF	Bit(3) 0 0-1
"CH5 Fault Mode State"	OFF	Bit(4) 0 0-1
"CH6 Fault Mode State"	OFF	Bit(5) 0 0-1
"CH7 Fault Mode State"	OFF	Bit(6) 0 0-1
"CH8 Fault Mode State"	OFF	Bit(7) 0 0-1

Figure 9.41: LK720 Output Setting under Program Mode

Communication Failure

- When communication failure occurs, the communication between controller and output module breaks and the "RUN" light flashes. The module may be in one of the following states in communication failure:
- After power on, module cannot establish communication with the controller, then LK720 will retain the initial status and its relay retains closed.
- Module in operation when communication failure (offline) occurs: module retains output (Hold Last State) or outputs a state (ON or OFF) preset in the configuration, known as the Fault Mode State. Whether the module retains output or outputs fault mode state can be configured in software.
- Module in program mode when communication failure occurs: module enters fault mode and outputs fault mode state. When failure recovered, module automatically returns to program mode and outputs program mode state again.
- If the module output has not been enabled, the module does not output fault mode state and retains the opening status even if any communication failure occurs.
- Under fault mode, whether the module retains output (Hold Last State) or outputs fault mode state is configured by user parameter "Fault Mode Output", whose default value is "Hold Last State". Fault mode state is configured by user parameter "Fault Mode State", default output of which is OFF (open). Parameters of each channel are configured separately without interfere to others.



Base parameters | DP parameters | Input/Output | User parameters

Length of user parameters in bytes: 3

Symbolic name

Parameters	Value	Allowed Values
"Program Mode Output"	Hold Last State	Bit(0) 0 0-1
"Fault Mode Output"	Hold Last State	Bit(1) 0 0-1
"CH1 Program Mode State"	OFF	Bit(0) 0 0-1
"CH2 Program Mode State"	OFF	Bit(1) 0 0-1
"CH3 Program Mode State"	OFF	Bit(2) 0 0-1
"CH4 Program Mode State"	OFF	Bit(3) 0 0-1
"CH5 Program Mode State"	OFF	Bit(4) 0 0-1
"CH6 Program Mode State"	OFF	Bit(5) 0 0-1
"CH7 Program Mode State"	OFF	Bit(6) 0 0-1
"CH8 Program Mode State"	OFF	Bit(7) 0 0-1
"CH1 Fault Mode State"	OFF	Bit(0) 0 0-1
"CH2 Fault Mode State"	OFF	Bit(1) 0 0-1
"CH3 Fault Mode State"	OFF	Bit(2) 0 0-1
"CH4 Fault Mode State"	OFF	Bit(3) 0 0-1
"CH5 Fault Mode State"	OFF	Bit(4) 0 0-1
"CH6 Fault Mode State"	OFF	Bit(5) 0 0-1
"CH7 Fault Mode State"	OFF	Bit(6) 0 0-1
"CH8 Fault Mode State"	OFF	Bit(7) 0 0-1

Figure 9.42: LK720 Output Setting under Fault Mode

9.4.6 Parameter Specifications

The controller can only read and write the I/O information regularly when the module entered data exchange mode after the initialization. Therefore, in order to provide correct parameter information in the initialization process, users shall first set the parameters in the PLC hardware configuration.

Communication Parameters

- Supporting PROFIBUS-DP slave station protocol, LK720 completes data exchanges and diagnosis information reporting with the controller and other DP master stations. Communication address is the DP module node number for the communication with the controller. In the PROFIBUS-DP bus link, a unique communication address is assigned to each module. If there is any error of the communication address, the slave station module will not be able to establish communication with the controller.
- Installed on the LK backplane, the unique communication address of LK720 module is determined only by its installation location. *Refer to Chapter 2: Backplanes for the details of communication address assignment.*
- As shown in Figure 9.43, the correct communication address shall be filled into the field "Station Address".
- If modules have been added or deleted in the configuration software, or the slot number of module on the backplane has been changed, the communication address in "station address" shall be checked to ensure the accuracy.

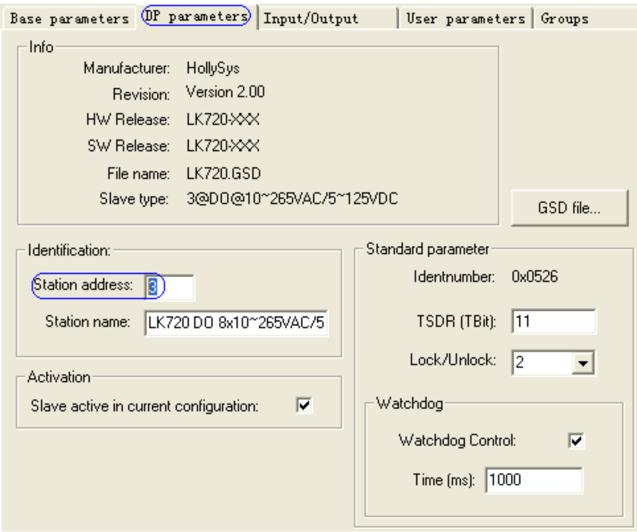


Figure 9.43: Communication Address of LK720

User Parameters

- User parameters are used to configure the module's operating mode. They are written into the controller during the download of user program and will not be read in every scanning circle. Each parameter has a default value that can be changed according to requirements of the project. User parameters do not support online modification; therefore they can only be effective after the full download.
- LK720 user parameter has 3 bytes (Byte0~Byte2):

Parameter Name	Parameter Definition	Value Options	Default Value
Program Mode Output	Setting of Program mode output	0: Hold Last State 1: Outputs program mode state	0
Fault Mode Output	Setting of fault mode output	0: Hold Last State 1: outputs fault mode safety state	0
CH1 Program Mode State	Program Mode State of Channel 1	0: OFF; 1: ON	0
CH2 Program Mode State	Program Mode State of Channel 2	0: OFF; 1: ON	0
CH3 Program Mode State	Program Mode State of Channel 3	0: OFF; 1: ON	0
CH4 Program Mode State	Program Mode State of Channel 4	0: OFF; 1: ON	0
CH5 Program Mode State	Program Mode State of Channel 5	0: OFF; 1: ON	0

CH6 Program Mode State	Program Mode State of Channel 6	0: OFF; 1: ON	0
CH7 Program Mode State	Program Mode State of Channel 7	0: OFF; 1: ON	0
CH8 Program Mode State	Program Mode State of Channel 8	0: OFF; 1: ON	0
CH1 Fault Mode State	Fault mode state of Channel 1	0: OFF; 1: ON	0
CH2 Fault Mode State	Fault mode state of Channel 2	0: OFF; 1: ON	0
CH3 Fault Mode State	Fault mode state of Channel 3	0: OFF; 1: ON	0
CH4 Fault Mode State	Fault mode state of Channel 4	0: OFF; 1: ON	0
CH5 Fault Mode State	Fault mode state of Channel 5	0: OFF; 1: ON	0
CH6 Fault Mode State	Fault mode state of Channel 6	0: OFF; 1: ON	0
CH7 Fault Mode State	Fault mode state of Channel 7	0: OFF; 1: ON	0
CH8 Fault Mode State	Fault mode state of Channel 8	0: OFF; 1: ON	0

Table 9.19: List of LK720 User Parameters

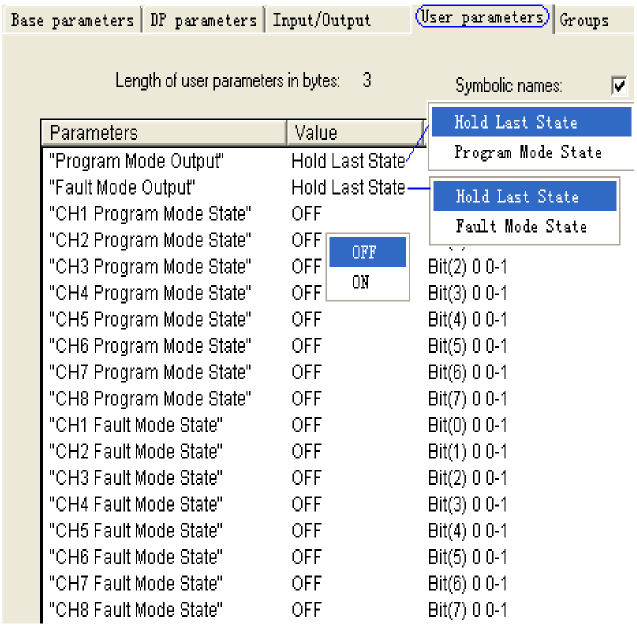


Figure 9.44: Setting of LK720 User Parameters

Specifications of Data Area

- Occupying 1 byte, the output data of LK720 control the closing and opening of 8 channel relays. The 1 byte input data feedback the current channel status in the form of readback data. Bit0~Bit7 are respectively corresponding to Channel 1 ~ Channel 8, as shown in Table 9.20.
- Since the module employs constantly open contact outputs, the initial status of the relay after power is open (OFF state) while output data is 0x00 and the channel indicator off. Value "0" indicates the channel is open, e.g. 0=OFF; Value "1" indicates the channel is closed, e.g.1=ON.
- The 1 byte readback data reports the channel output status to the controller for the user programming.

Area Definition	Data Length		Data Definition	Value Range
Output Data	1Byte	Bit0	Channel 1 output, 1=close; 0=open	0x00~0xFF
		Bit1	Channel 2 output, 1=close; 0=open	
		Bit2	Channel 3 output, 1=close; 0=open	
		Bit3	Channel 4 output, 1=close; 0=open	
		Bit4	Channel 5 output, 1=close; 0=open	
		Bit5	Channel 6 output, 1=close; 0=open	
		Bit6	Channel 7 output, 1=close; 0=open	
		Bit7	Channel 8 output, 1=close; 0=open	
Input Data	1Byte	Bit0	Channel 1 output readback, 1=close; 0=open	0x00~0xFF
		Bit1	Channel 2 output readback, 1=close; 0=open	
		Bit2	Channel 3 output readback, 1=close; 0=open	
		Bit3	Channel 4 output readback, 1=close; 0=open	
		Bit4	Channel 5 output readback, 1=close; 0=open	
		Bit5	Channel 6 output readback, 1=close; 0=open	
		Bit6	Channel 7 output readback, 1=close; 0=open	
		Bit7	Channel 8 output readback, 1=close; 0=open	

Table 9.20: List of LK720 Input/Output Data

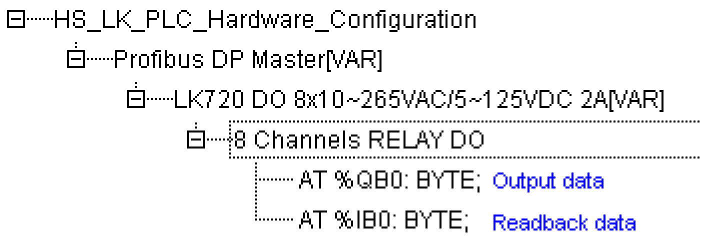


Figure 9.45: LK720 Input/Output Data

9.4.7 Module Installation and Un-installation

Refer to chapter I on "Module Insertion Mechanical keys" and "Module Insertion and Removable" for more details.

9.4.8 Technical Specification

LK720 8-Channel 10~265VAC/5~125VDC Relay Output Module		
System Power Supply		
Power Supply Voltage	24VDC (-15% ~ 20%)	
Power consumption	150mA max@24V DC	
Output Channel		
Number of Channels	8 channels;	
Signal Type	Non source open contact	
Valid load voltage range	10~265VAC@47~63Hz/5~125VDC	
Load voltage range (load control)	Resistance load	
	5~30VDC@2A	
	48VDC@0.5A	
	100VDC@0.2A	
	125VAC@2A	
	240VAC@2A	
Rated output current (stable status)	Resistance load	Inductive load
	2A@5~30VDC	2A@5~30VDC
	0.5A@48VDC	0.5A@48VDC
	0.2A@100VDC	0.2A@100VDC
	2A@125VAC	2A@125VAC
	2A@240VAC	2A@240VAC

Rated power (stable status)	Resistance load	Inductive load
	125VAC, 250W max.	125VAC, 250W max.
	240VAC, 480W max.	240VAC, 480W max.
	30VDC, 60W max.	30VDC, 60W max.
	48VDC, 24W max.	48VDC, 24W max.
	100VDC, 20W max.	100VDC, 20W max.
Minimum load current	10mA / point	
Maximum OFF-state Current Leak	1.5mA	
Initial contact resistance	30mÙ	
Maximum connection frequency at rated load	6 times / minute	
Minimum connection frequency at rated load	1200 times / minute	
Bounce time	1ms;	
Operating time	5ms;	
Release time	1ms;	
Relay contact life span Resistance load Inductive load	 200, 000 times 30, 000 times	
Maximum Output Delay Time OFF→ON ON→OFF	 10ms; 10ms	
Configurable fault mode output state of each point	Hold Last State (default); ON of OFF	
Configurable program mode output state of each point	Hold Last State (default); ON of OFF	
Isolation Voltage Field to System Channel to channel	 1000VAC@1min, Current Leak 5mA 1000VAC@1min, Current Leak 5mA	
Failure Diagnosis and Hot Swap		
Field Power Loss Detection	Field power loss: device diagnosis byte 0x04; Power loss recovered: diagnosis byte 0x00	
Hot Swap	Support	
Communication Bus		
Protocol	PROFIBUS-DP Slave Station, in accordance with IEC61158-3/EN50170 standards	
Baud Rate	Baud Rate Options: 1.5Mbps, 500Kbps, 187.5Kbps, 93.75Kbps, 45.45Kbps, 31.25Kbps, 19.2Kbps, 9.6Kbps	
Media	Communication bus is connected to the backplane through euro connector, hot redundant communication media	
Physical Features		
Mechanic Keys to Prevent Incorrect Insertion	D3	
Installation	LK local backplane or expansion backplane	
Dimension	Width × Height × Depth = 35mm×100mm×100mm	
Casing Protection Level	IEC60529 IP20	
Weight	210g	
Working Environment		
Working Temperature	0℃~60℃	
Working Relative Humidity	5%~95%, no condensate	
Storage Temperature	-40℃~70℃	
Storage relative Humidity	5%~95%, no condensate	

Table 9.21: Technical Specification of LK720 Module

Chapter 10

CHAPTER 10: SPECIAL FUNCTION MODULES

10.1 LK630 16-CHANNEL 24VDC SINK SOE MODULE

10.1.1 Features

- 16 channels of sink SOE inputs
- Field power voltage range: 10 ~ 31.2VDC
- Controller Synchronization / GPS synchronization
- 1ms SOE resolution
- Synchronization Signal Expiry Diagnosis
- Field Power Loss Detection
- Channel reverse protection
- Support ProfiBus-DP Slave Station Protocol
- System-to-Field Isolation
- Supports hot swap

10.1.2 Operation Principles

Threshold Level of LK630:

- Logic 1: voltage range 10~31.2VDC, Current 2mA (10VDC) ~ 10mA (31.2VDC)
- Logic 0: maximum voltage 5VDC, maximum current 1.5mA

As shown in Figure 10.1, one end of the switch connects to the positive end of field power supply while the other end connects to LK630. When the switch is closed, current goes into the optical couple from the switch and returns to the negative end of field power supply through it.

When input voltage is in the range of 10~31.2VDC, the Light Emitting Diode (LED) side of the optical coupler is connected and the trigger outputs a high voltage level; when input voltage is lower than or equals to 5VDC or the input current is smaller than or equals to 1.5mA, the LED side of the optical coupler is disconnected and the trigger outputs a low voltage level.

RC filter circuit filters and debounces the input voltage while the diode provides the reverse protection function.

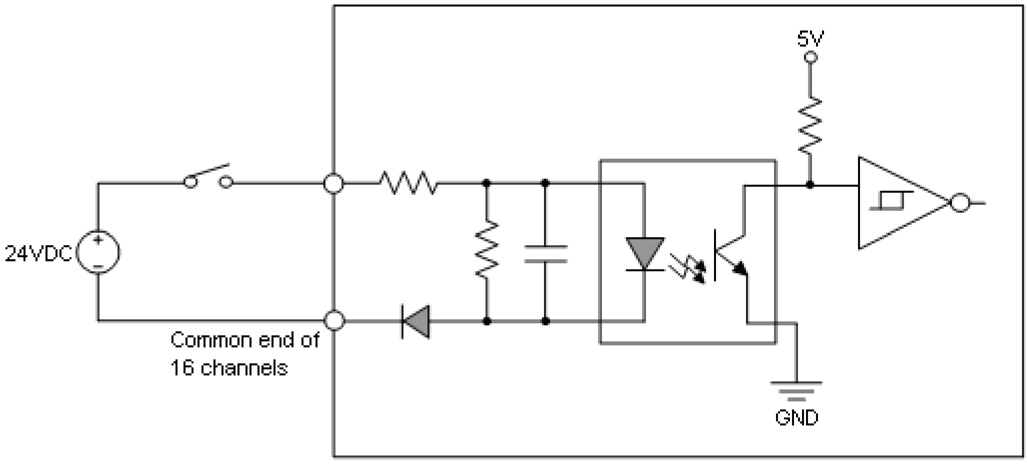


Figure 10.1: LK630 Input Channel Interface Circuit

10.1.3 Indicators Definition

RUN indicator (Green)	On	Communication is established, module in normal operation
	Flash	Communication is not established or communication error
	Off	Power Off or Module Failure
Channel01~16 Indicators (Yellow)	On	The channel is closed
	Off	Channel is opened

Table 10.1: Definition of LK630 Indicators

Specifications of RUN green light are as follows:

- After the power is on, the module waits for initialization data while the green light flashes with a frequency of 4 times per second.
- After the initialization is completed, the green light is constantly on to indicate the module in normal operation; if any error occurs in the initialization, then the communication is not established and the green light keeps flashing. Then, setting s of communication parameters (slave station address, etc) shall be checked.
- Green light is constantly on in normal communications; green light flashes when communication breaks; green light returns to constant on when communication re-established.

10.1.4 Wiring Specifications

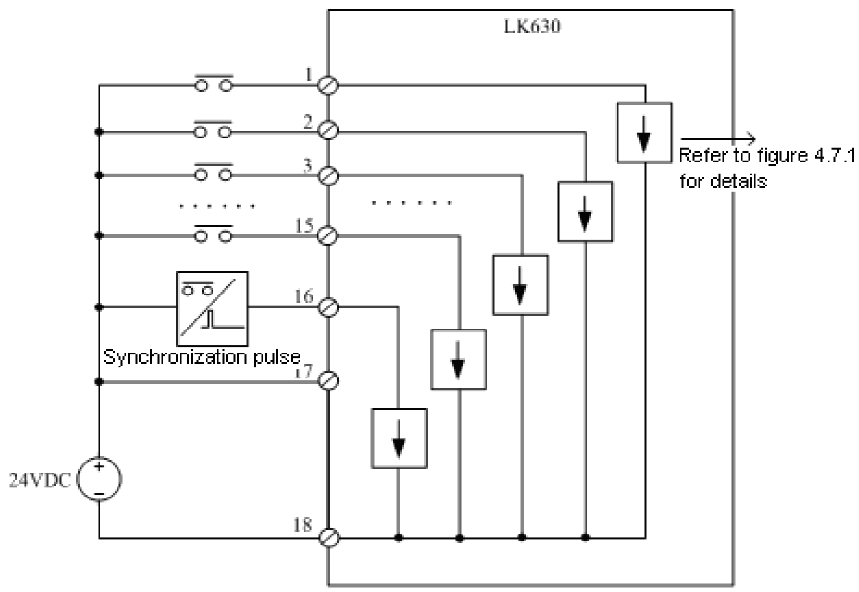


Figure 10.2: LK630 16-Channel 24VDC Sink SOE Module

LK630 adopts 16 channels of dry contacts for its SOE event contacts, hence a field power supply is needed to drive its optical coupler. To ensure the isolation between field and system, this 24VDC field-side power supply shall be separated from the backplane power supply.

LK630 modules are installed on LK backplanes, which support two types of wrings: terminal wiring and prefabricated cable wring.

Wiring to Backplane Terminals

Wiring of 16 Channels SOE

LK630 module is connected to field signals through the correspondence terminals right under its backplane installation slot. The relationship between each channel and terminal is shown in Figure 10.3.One ends of the 16 channel SOE contacts connect to the wiring terminals (01~16) of the correspondence channels while the other ends short connect to the positive end of field-side power supply.

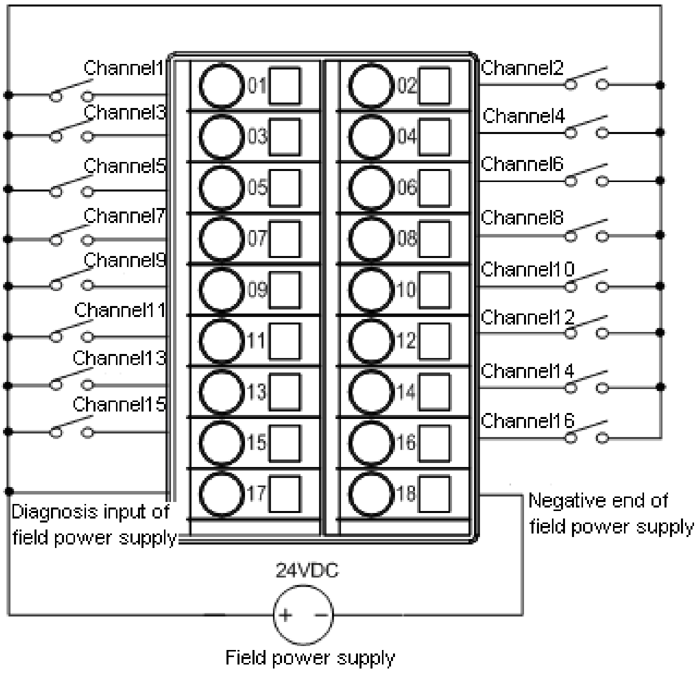


Figure 10.3: Wiring of LK630 16-Channel SOE Backplane Terminals

In the wiring, the following shall be noted:

- External separated 24VDC field power supply.
- Terminal "1~16" are the input ends of the Channel 1~16 SOEs.
- Terminal "17" connects to the positive end of the field power supply to enable the field power loss detection.
- Connecting to the negative end of the field power supply, terminal "18" is the common end of Channel 1~16 inside the module.
- A single terminal shall not be connected to many wires; therefore multiple-point connection can be established through bus bar or transferring terminal board.

Wiring of 15 Channels of SOE + 1 Channel of Synchronization Pulse

Under hardware synchronization mode, LK630 connects to 15 channels of SOE while its 16th channel connects synchronization signal inputs, the relationship between each channel and terminal is shown in Figure 10.4. One ends of the 15 channel SOE contacts connect to the wiring terminals (01~15) of the correspondence channels while the other ends short connect to the positive end of field-side power supply. The synchronization signal is a digital pulse with 1 second width that shares with 24VDC field power supply with SOE signals The positive end of synchronization signal connects to the positive end of the field power supply positive end while its negative end connects to Terminal "16".

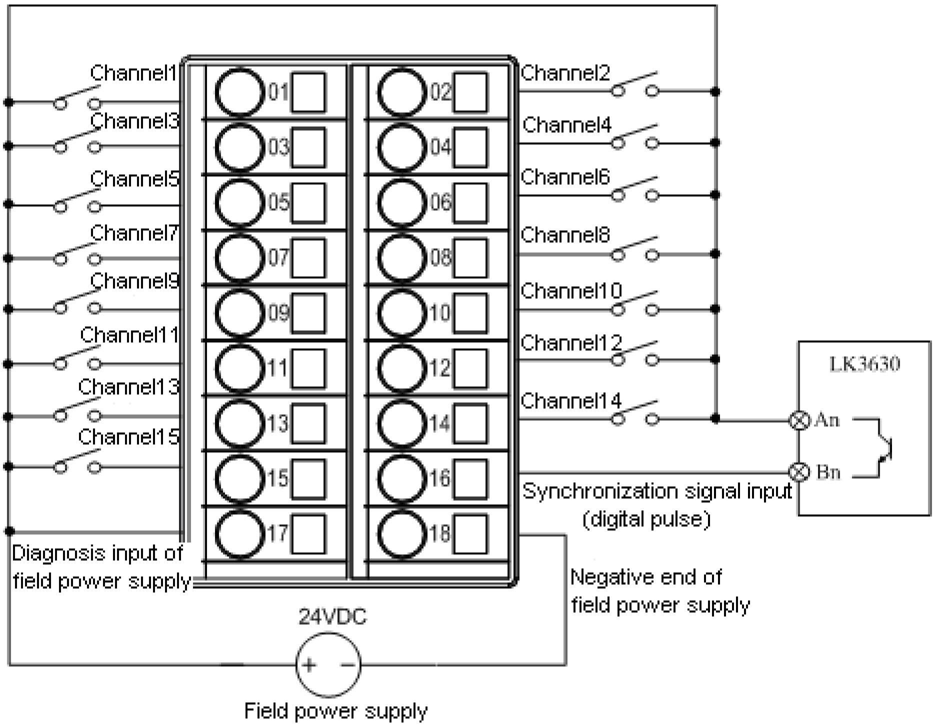


Figure 10.4: Wiring of LK630 15-Channel SOE + 1-Channanl Synchronization Signals Backplane Terminals

In the wiring, the following shall be noted:

- External separated 24VDC field power supply.
- Terminal "1~15" are the input ends of the Channel 1~15 SOEs.
- Terminal 16 connects to the digital pulse signals for GPS synchronization.
- Terminal "17" connects to the positive end of the field power supply to enable the field power loss detection.
- Connecting to the negative end of the field power supply, terminal "18" is the common end of Channel 1~16 inside the module.
- A single terminal shall not be connected to many wires; therefore multiple-point connection can be established through bus bar or transferring terminal board.

Wiring to Terminal Modules

Please refer to the information found on Chapter 12: Terminal Module.

10.1.5 Synchronization Modes

There are two modes of SOE synchronization:

- Sending synchronization pulse signals through GPS synchronization module (Controller Synchronization).
- Sending synchronization broadcast package through the controller (Software Synchronization).

Under GPS synchronization mode, with its 16th channel connects to the synchronization pulse, LK630 only samples 15 channels of SOE data.

Under controller synchronization mode, the synchronization signals are sent to each LK630 module without occupying its input channel so that the module can sample 16 channels of SOE data.

LK630 selecting its synchronization mode through user parameter "Time Synchronization Mode". The default setting is GPS synchronization.

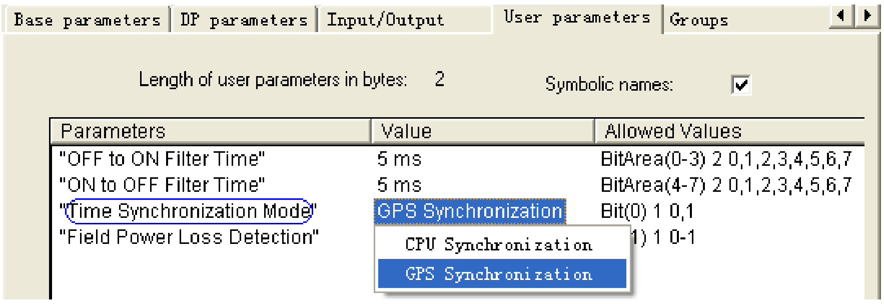


Figure 10.5: Selection of LK630 Synchronization Mode

The completed time information of 1 SOE event consists of two parts:

- Time that has higher units than minute (Year Month Day Hour) is the current time of the controller. Current time of different controller is synchronized by SOE synchronization module.
- Time that has units lower than minute (minute second millisecond) are reported to the controller by SOE modules. SOE module import synchronization pulse signals through hardware ports.

When SOE time arrives, SOE module records the minute and millisecond value of the moment when the event happens and reports the value to the controller. Then the controller will combine the value with the time value with higher time units to obtain the complete SOE event time information.

GPS Synchronization

SOE synchronization module connects to GPS clock source and imports time information through serial port (RS232 or RS485) as the synchronization signals. As the synchronization channel, the 16th channel of LK630 receives the synchronization sub-pulse signals assigned by LK3630. This sub-pulse is a digital pulse (dry contact) with 1secnod width, e.g., the sub-pulse maintains 1second high level and 59scond low level.

Several SOE modules shall receive the same synchronization pulse signal assigned by LK3630 SOE Synchronization Terminal module that divides 1 channel pulse signal into 16 channels or more same sub-pulse for LK630 modules.

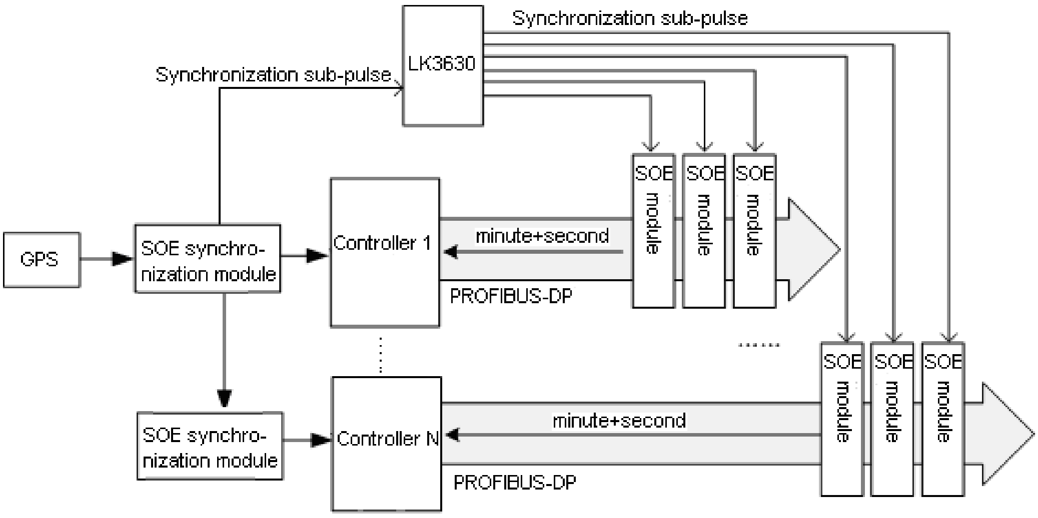


Figure 10.6: GPS Synchronization Mode of LK630

Controller Synchronization

The controller sends out synchronization data package to SOE modules by network broadcasting. The data package provides the same function as a synchronization pulse signal. A controller only sends synchronization data package to the SOE modules connect to it, so there can be errors of the synchronization sending times between different controllers. Hence the SOE events between different controllers have a lower accuracy in the controller synchronization mode than in the GPS synchronization mode.

Since the controller only sends synchronization packages to the slave station in Group 2, LK630 module shall be added into Group 2 under the controller synchronization mode. *Refer to section of "Parameter Specifications" for more details.*

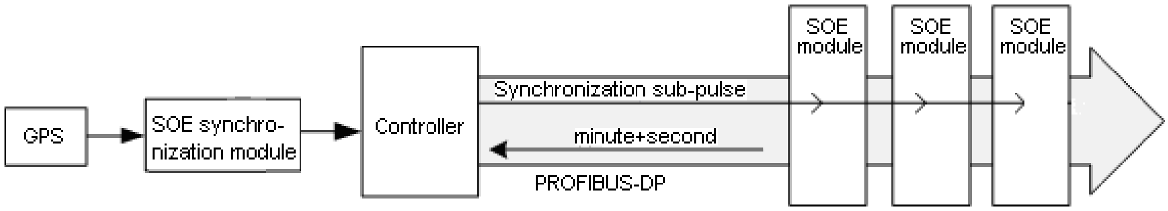


Figure 10.7: Controller Synchronization Mode of LK630

Due to the limit on DP data size (3583 bytes for input and output area respectively), one controller shall be connected with no more than 28 SOE modules (the input area of each SOE module is 124 bytes).

In short, controller synchronization mode is recommended when there are less SOE events and all SOE modules are connected to the same controller. On the other hand, GPS synchronization mode is recommended when there are more SOE events and SOE modules are connected to different controllers.

10.1.6 SOE Capacity

Since the controller inquires into all slave stations without halts, when there are large amount of SOE events, the whole SOE records cannot be read and reported in time. Therefore, LK630 is designed with storage of certain capacity to store the unprocessed SOE event in the controller sample period.

SOE module reports SOE events to the controller in the form of data package. Each package can contain maximum 20 SOE events. The SOE events that are not processed in time shall be stored in the secondary buffer. When SRAM is selected as the secondary buffer, maximum 1023 SOE events can be stored. When a SOE data package has been read by the controller, the data package number is returned to the SOE module as the feedback information. After the module receives this information, it clears the data in the buffer.

In normal communication, CPU regularly reads the data in the primary buffer of data sampling function block and store them into the secondary buffer. At the same time, it sends out SOE data packages to report the SOE events in secondary buffer to the controller.

When communication with the controller halts, module keeps on recording SOE events and stored them in the primary buffer of data sampling function block. The SOE event records in the buffer can be retained unless the module is power off. Data in the primary buffer will still be read by the CPU but with a longer interval. When there are 41 records of unread SOE event, the module does not keep on recording. Meanwhile, the unreported SOE data in SRAM are retained too. If the SRAM is full, a data exceeding shall be generated and it does not record any further SOE data. Until the communication with the controller is re-established and the module begins to sent SOE data packages (maximum 20 SOE events in every package) and receive feedback information from the controller again, the reported SOE event in the buffer shall be cleared and new SOE event be recorded.

In case the communication halting time is longer than 50 minutes, the module will automatically clear the SOE buffer that all unreported events shall be cleared as in power off or module swap.

After power on, the module will only begin to record SOE events when it receives valid synchronization information and valid minute information sent by the controller. This waiting time is about 1.5 minutes.

10.1.7 Reverse Protection

LK630 connects a diode in series at the power input negative end for the reverse protection. It protects the internal circuit from any damages when there is wrong connection of the field power positive and negative ends.

10.1.8 Diagnosis Specifications

PowerPro V4 configuration software adopts external diagnosis library to check and acquire all kinds of diagnosis information, such as whether the module and its channels are operating normally, whether the field power supplying smoothly and whether the module parameters are set correctly.

For the DP slave station modules, the DP slave station expansion diagnosis function block (HS_DPSlaveALarm) shall be called to check the DP module at any address (DP_Addr) on the PROFIBUS-DP link, as shown in Figure 10.8.

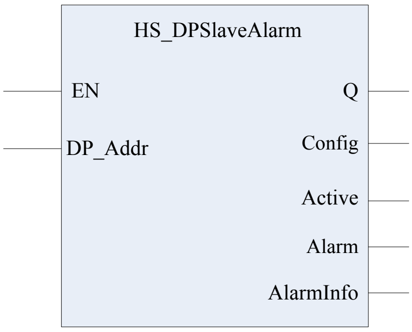


Figure 10.8: Expansion Diagnosis Function Block for DP Slave Station

For detailed usage of DP Expansion Diagnosis Function Block, please refer to LK Large Scale PLC Instruction Manual. Users shall note that the Diagnosis library is an external library that shall be first installed in the Library Manager before use.

The diagnosis information of DP slave station modules can be classified to 3 categories: device diagnosis, identifier diagnosis and channel diagnosis. All diagnosis data exist in the form of block structure.

- Device Diagnosis: records of the overall diagnosis information of the module, such as, power loss of field power supply.
- Identifier Diagnosis: records of whether the module has diagnosis information.
- Channel Diagnosis: records of the channel level diagnosis information, such as line break and range exceeding.

LK630 provides signal expiry diagnosis and field power loss detection, which are both device diagnoses. Definition of LK630 diagnosis byte is shown in Figure 10.9.

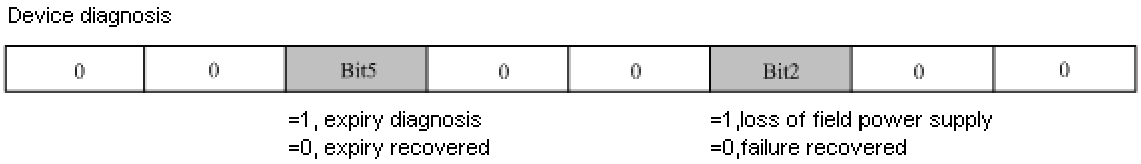


Figure 10.9: LK630 Diagnosis Byte

After the DP slave station expansion diagnosis function block (HS_DPSlaveAlarm) is called, the device diagnosis data reported by LK630 will be stored in the corresponding output fields of parameter "AlarmInfo", as shown in Table 10.2.

Device Diagnosis	Value	Definition
ALarmInfo.DevDiag.Data[1]	0X04	Field Power Loss
	0X20	Module expiry, module has not receive synchronization information for more than 65 seconds
	0x24	Field power loss and module expiry
	0x00	Failure Recovered

Table 10.2: Definition of LK630 Diagnosis Information

Field Power Loss Detection

- LK630 provides field-side power loss detection. Whether to enable this function can be selected by user parameter "FieldPowerLossDetection", the default setting of which is "Enable". Modifications can only be effective after the full download.
- Terminal "17" connects to the positive end of field power supply while terminal "18" connects to its negative end. LK630 conducts the power loss detection by checking the changes of input voltage between the two terminals. In case of any failure, the failure status will be reported to the controller as the diagnosis data.
- When the field 24VDC power supply is lost (disconnected or power supply voltage <5VDC), the device diagnosis data area of LK630 generates diagnosis byte 0x04 (Bit2 of diagnosis byte = 1) and report it to the controller.
- When the field 24VDC power supply is recovered (power supply voltage 10~31.2VDC), the device diagnosis data area of LK630 generates new diagnosis byte 0x00 (Bit2 of diagnosis byte =0) and reports it to the controller.

- LK630 module will only report the diagnosis data once respectively when failure occurs and is recovered.

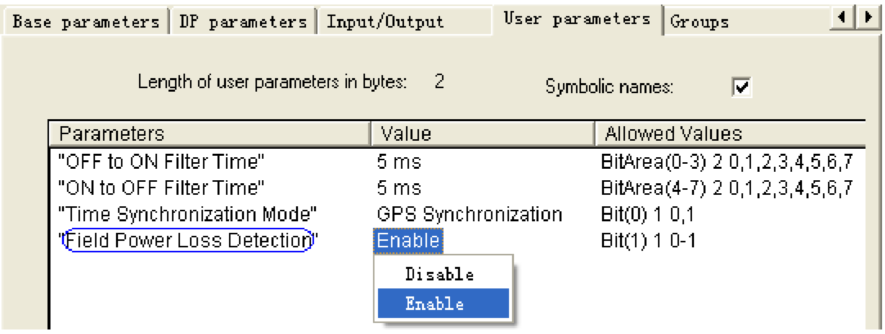


Figure 10.10: Selection to Enable LK630 Power Lost Detection

Synchronization Signal Expiry Diagnosis

- The expiry diagnosis is always valid. Under GPS synchronization mode, it check whether the synchronization channel receives pulse signals every minute. Under controller synchronization mode, it check whether the module receives synchronization data package every minute. If the module has not received synchronization information for more than 65 seconds, its diagnosis data area generates diagnosis byte 0x20 (Bit5 of the diagnosis byte =1) and reports it to the controller in the next scan period.

10.1.9 Parameter Specifications

The controller can only read and write the I/O information regularly after it entered data exchange mode. Therefore, in order to provide correct parameter information in the initialization process, parameters shall be first set in the PLC hardware configuration of software PowerPro V4.

After adding "LK630 SOE 15/16x24VDC Sink" in the PROFIBUS-DP link, user can configure the hardware parameters of LK630.

Communication Parameters

- Communication address is the DP module node number for the communication with the controller. In the PROFIBUS-DP bus link, a unique communication address is assigned to each module. If there is any error of the communication address, the slave station module will not be able to establish communication with the controller.
- Installed on the LK backplane, the unique communication address of LK630 module is determined only by its installation location. *Refer to Chapter 2: Backplanes for the details of communication address assignment.*
- As shown in Figure 10.11, the communication address of LK630 module shall be filled into the field "Station Address".
- If modules have been added or deleted in the configuration software, or the slot number of module on the backplane has been changed, the communication address in "DP Parameter" shall be check to ensure the accuracy.

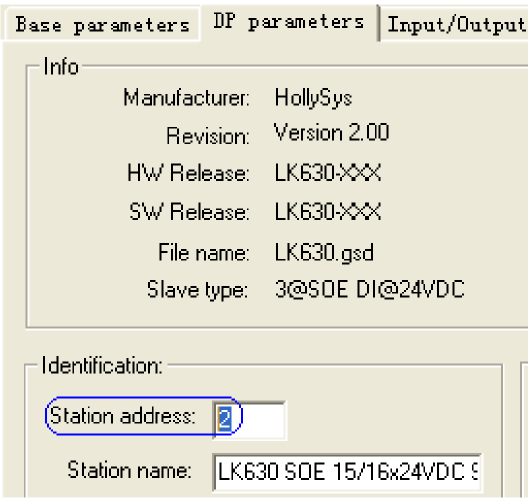


Figure 10.11: Setting of LK630 Communication Address

User Parameters

- User parameters are used to configure the module's operating mode. They are written into the controller during the download of user program and will not be read in every scanning circle. Each parameter has a default value that can be changed according to requirements of the project. User parameters do not support online modification; therefore they can only be effective after the full download.

- User parameters of LK630 include software filter time selection, synchronization mode selection and that to enable field power loss detection. The definition of parameters is shown in Table 10.3.

Parameter Name	Parameter Definition
OFF to ON Filter Time	OFF→ON (rising edge) transition software filter time =0, 1ms =1, 3ms =2, 5ms (Default) =3, 10ms =4, 15ms =5, 20ms =6, 25ms =7, 30ms
ON to OFF Filter Time	ON→OFF (falling edge) transition software filter time =0, 1ms =1, 3ms =2, 5ms (Default) =3, 10ms =4, 15ms =5, 20ms =6, 25ms =7, 30ms
Time Synchronization Mode	Selection of SOE synchronization mode =0, CPU Synchronization, Controller Synchronization =1, GPS Synchronization, GPS synchronization (default)
Field Power Loss Detection	Enable Field Power Supply Loss Detection =0, Disable, the function is disabled; =1, Enable, the function is enabled (default);

Table 10.3: Definition of LK630 User Parameters

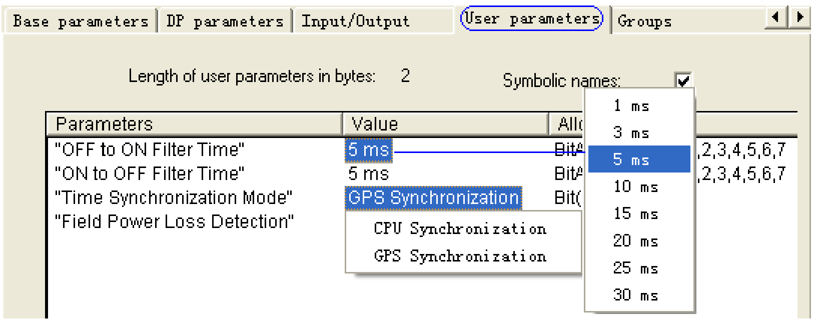


Figure 10.12: LK630 User Parameter Interface

Group Parameters

- Under controller synchronization mode, the controller sends out synchronization package through the multicasting method to send the time information into a selected group. Only the slave station modules in this group can receive the time information.
- The controller is configured to send time package to Group 2, so that LK630 module shall be added into Group 2 to receive the synchronization information. As shown in Figure 10.13, to add the module, the "Gr2" of its hardware parameter "Group" tab shall be selected and clicked on to add a "+".

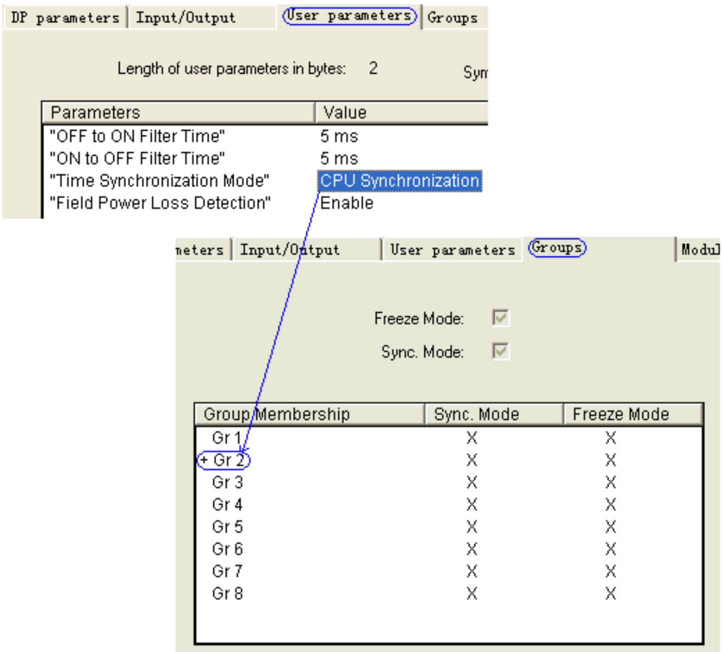


Figure 10.13: Setting of Group under Controller Synchronization Mode

Specifications of Data Area

- As shown in Figure 10.14, the controller SOE data area contains 1 WORD length of output data and 62 WORD length of input data. Existed in the form of variables, input data in user program can update maximum 20 SOE event records at once. SOE function block (HS_DP_SOE_READ) can be called to read the SOE event records.
- Output data are sent out by the controller.

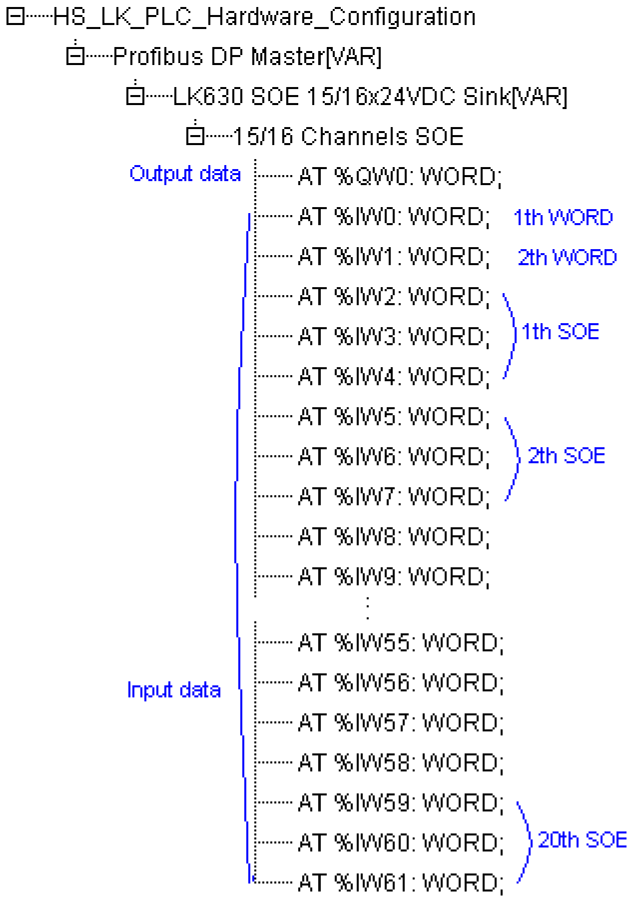


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Figure 10.14: LK630 Data Area Interface

Output Data

- Transmitted by the controller, output data are not affected by user configurations.
- High byte is the feedback inform of controller receiving the SOE data. The feedback information is the reported data package number.
- Low byte is the minute value sent by the controller. In every scan period, the controller sends current minute time to the SOE module in the form of output data.

Output Data	WORD	WORD Definition	Specifications
Controller transmission	Bit15~Bit8	SOE data package number (1-255), e.g. high byte of the 2nd WORD of output data.	The feedback information of controller receiving SOE data package indicates the data of this package has been read.
	Bit7~Bit0	Current time in minute (0~59)	Reports 0xc8 after power on to indicates the synchronization of controller does not started yet.

Table 10.4: Definition of LK630 Output Data

Input Data

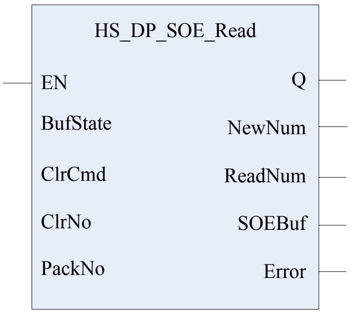
- The first WORD represents the current real-time status of the 16 channels in data exchange. The second WORD indicates the number of reported SOE event and the package number of reported SOE package at the time. Every 3 WORDs of the following data consists of one SOE records, maximum 20 SOE records.

Input Data	WORD Order	WORD Definition (16bit)	Specifications
SOE module report	1	Current status of SOE channel	Bit0~15 to Channel1~16
	2	Bit7~Bit0: Number N (0~20) of the reported SOE events at the time, maximum 20 SOE records at once Bit15~Bit8: Package No (1~255) of the reported SOE event at the time for the controller to identify	N=0, no SOE event
	3	Millisecond time (0~65535ms) when the 1st SOE event happened	1st SOE event record
	4	Channel status when the 1st SOE event happened Bit0~15 to Channel1~16	
	5	Bit7~Bit0: Channel transition status when the 1st SOE event happened Bit15~Bit8: Minute time (0~59) when the 1st SOE event happened	
	...	...	...
	60	Millisecond time (0~65535ms) when the 20th SOE event happened	20th SOE event record
	61	Channel status when the 20th SOE event happened Bit0~15 to Channel1~16	
	62	Bit7~Bit0: Channel transition status when the 20th SOE event happened Bit15~Bit8: Minute time (0~59) when the 20th SOE event happened	

Table 10.5: Definition of LK630 Input Data

Function Block Specifications

- In PowerProV4, external library is called to enable the SOE event data reading function. After the external library HS_SOE.Lib is added to the library manager, SOE function block HS_DP_SOE_Read can be called to read SOE event data. SOE function block provides a user interface to read SOE events.
- Controller regularly reads the SOE event data of SOE module LK630 and reports new SOE event to the server. SOE events reported by the SOE module are stored in the dual-port RAM of the controller. For the further processing of host computer (The control terminals of upper network are all called host computer.), users can read SOE event data from the RAM and store them in the buffer by calling the SOE function block. SOE events in the buffer can be uploaded to the server through network as data package, maximum 50 SOE events in a package.



Input Parameter	Data Types	Functions Description	Parameter Specifications
EN	BOOL	Enabled	0: disabled (default) 1: enabled
BufState	BYTE	Buffer state	Indicate whether the buffer is full. After filled in the SOE data, the controller sets this bit as 1. If the controller find that the bit is 1 when it fills the buffer, then it will not rill any new data to the buffer. The host computer reset this bit to 0 after read the SOE data. 0: buffer not full 1: buffer full
ClrCmd	BYTE	Clear command	Sent by host computer, indicating whether data in buffer need to be cleared 0: hold current data (default) 1: clear command
ClrNo	BYTE	No. of the SOE package that needs to be cleared	Sent by host computer, indicating the No. of SOE package that needs to be cleared.. 1 (Default) ~255
PackNo	BYTE	SOE package number	Function block automatic numbering 1~255, loop count
Output Parameter	**Data Types**	**Functions Description**	**Parameter Specifications**
Q	BOOL	Mark of output completed	0: output not completed; 1: output completed
SOEBuf	stcSOEData	Buffer that stores SOE events	Buffer to store SOE events, maximum storage of 50 SOE events.
ReadNum	WORD	Number of SOE events that have been read	1~50, number of SOE events stored in the buffer.

Table 10.6: SOE Function Block Specifications

Output end data structure of PowerProV4 function block is shown in Figure 10.15.

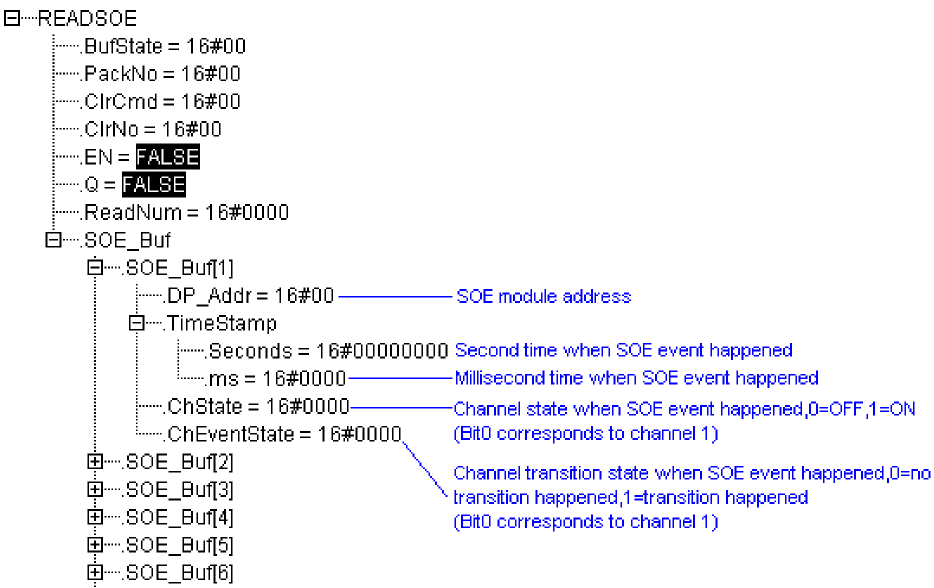


Figure 10.15: SOE Function Block Output End

For more information, please refer to LK Large Scale PLC Instruction Manual.

10.1.10 Module Installation and Un-installation

Refer to chapter 1 on "Module Insertion Mechanical keys" and "Module Insertion and Removable" for more details.

10.1.11 Technical Specification

LK630 16-Channel 24VDC Sink SOE Module		
Power Supply		
Input Voltage		24VDC (-15% ~ 20%)
Power consumption		80mA max@24V DC
Signal Channel		
Number of Channels		15+1 / 16 channels
Field Power Supply		24VDC
Threshold voltage Level(Vth)	ON	10(2mA)~31.2VDC(10mA)
	OFF	0~5VDC(1.5mA)
Debounce filter time	OFF→ON	Configuration options: 1ms, 3ms, 5ms (default), 10ms, 15ms, 20ms, 25ms, 30ms
	ON→OFF	Configuration options: 1ms, 3ms, 5ms (default), 10ms, 15ms, 20ms, 25ms, 30ms
Hardware Delay		50ìs
Diagnosis functions	Power loss detection	Field power loss: Device diagnosis byte Bi2 =1; Failure recovered: Bit2=0
	Expiry diagnosis	Module has not receive synchronization information for more than 65 seconds: diagnosis byte Bit5=1; Failure recovered: Bit5=0
Reverse Protection		Provided
Hot Swamp		Support
Isolation Voltage		
Isolation voltage between input contacts and system		500V AC 1min Testing, Current Leak 5mA
SOE Functions		
SOE resolution		1ms
Sample Period		0.833us
SOE Synchronization Mode		Controller Synchronization / GPS Synchronization (default), configurable
SOE Synchronization Interval		1 minute
SOE storage	Primary buffer	Unread SOE, maximum storage of the first 42 events
	Primary buffer	Unreported SOE, maximum storage of the first 1023 events
Communication		
Protocol		PROFIBUS-DP Slave Station, in accordance with IEC61158-3/EN50170 standards
Dual Network Redundancy		Support
Communication Rate		9.6Kbps, 19.2Kbps, 45.45Kbps, 93.75Kbps, 187. 5Kbps, 500Kbps, 1.5Mbps
Physical Features		
Installation method		Installation slot
Installation Location		LK local backplane or expansion backplane
Mechanic Keys to Prevent Incorrect Insertion		D0
Dimension		Width × Height × Depth = 35mm×100mm×100mm
Casing Protection Level		IEC60529 IP20
Weight		195g
Working Environment		
Working Temperature		0°C~60°C
Working Relative Humidity		5%~95%, no condensate
Storage Temperature		-40°C~70°C
Storage relative Humidity		5%~95%, no condensate

Table 10.7: Technical Specification of LK630 Module

10.2 LK620 24VDC 2-CHANNEL COUNTER MODULE

10.2.1 Features

- 2-channel counters
- Bidirectional counting, frequency measurement
- Z signal inversion
- Storing counter values
- Input filtering
- Module inhibition function
- Program mode output
- Fault Mode Output
- Field Power Loss Detection
- System-to-Field Isolation
- Support PROFIBUS-DP slave station protocol
- Supports hot swap
- Installed on local backplanes or expansion backplane

10.2.2 Operation Principles

The LK620 2-channel counter module has two independent built-in counters, and each counter has three inputs (A, B and Z) and two digital outputs.

Input signal effective voltage range is 10~26.4VDC, and current range is 2.2mA (10VDC) ~ 7mA (26.4VDC). Reference to Figure 10.16, one end of the load is connected to the negative of the field power supply, and the other end is connected to LK620. When the MOSFET electronic switch is closed, the current from the switch provides power to the load, and the 4 switches share the same power supply inside the module.

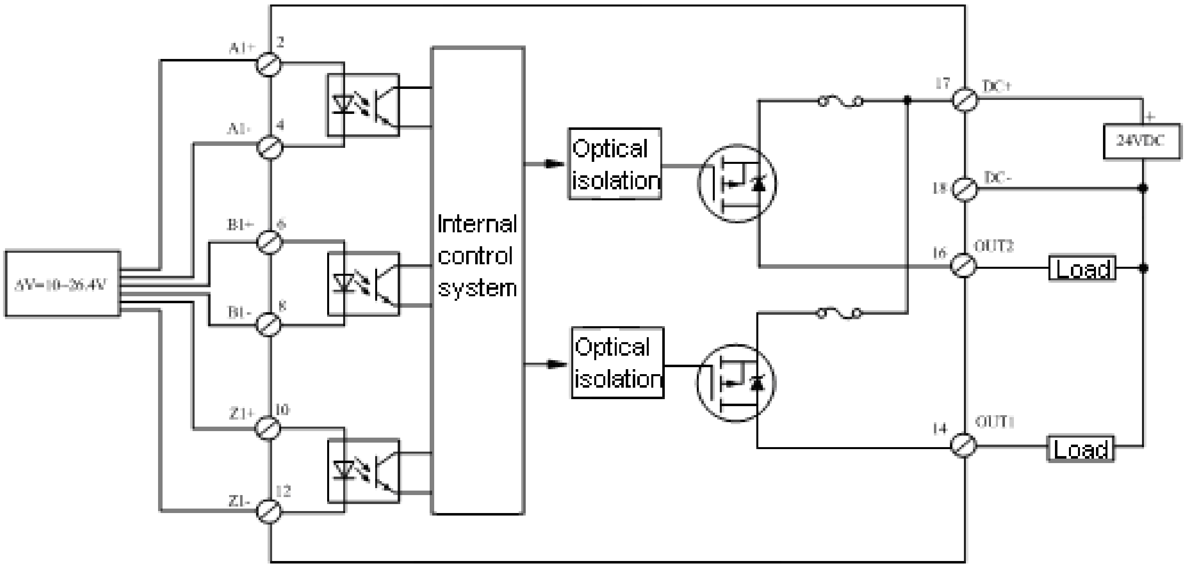


Figure 10.16: LK620 Channel Interface Circuit (Taking Counter 1 as Example)

10.2.3 Operation Modes

LK620 is mainly used to measure pulse inputs of photoelectric encoders and proximity sensors. There are four operation modes to choose from, namely, counter mode, encoder x 1 mode, encoder x 4 mode, and frequency measuring mode. Wherein, the frequency measuring mode can be used to measure frequencies in the range of 0.1Hz~1MHz.

The operation mode of counter 1 can be selected by the parameter "Counter1OperationalMode"; the operation mode of counter 2 can be selected by the parameter "Counter2OperationalMode", and the default setting for the parameters is (Counter Mode).

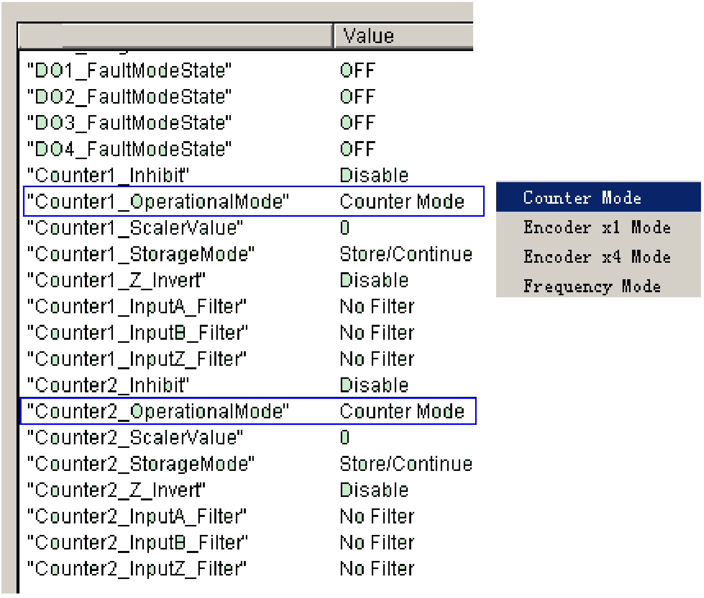


Figure 10.17: Choosing L620 operation modes

10.2.4 Counter Mode

Under the Counter Mode, A is the input pulse signal, where the highest allowed input signal frequency is 1MHz. B is the direction signal input. The counter starts counting on the rising edge of the signal at A, and the direction of counting is determined by the signal at B. When the level of the signal at B is low, the counter will increment its count, and when the level of the signal at B is high, the counter will decrement its count.

Input B	Counting direction
High level	Decrement
Low level (or open)	Increment

Table 10.8: LK620 counting directions under Counter Mode

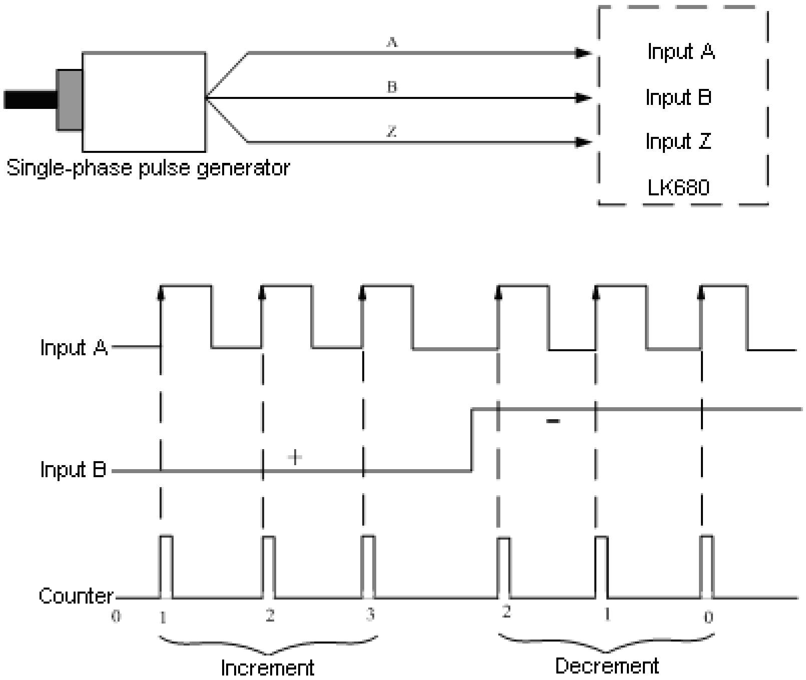


Figure 10.18: Counter mode of LK620.

10.2.5 Encoder x 1 Mode

Under the Encoder x 1 Mode, the highest frequency allowed at inputs A and B is 250 KHz, and they should maintain a phase difference of 90°. When A is 90° ahead of B, the counter increments its count, and starts

counting on the rising edge of the signal at A. When B is 90° ahead of A, the counter decrements its count, and starts counting on the falling edge of the signal at A.

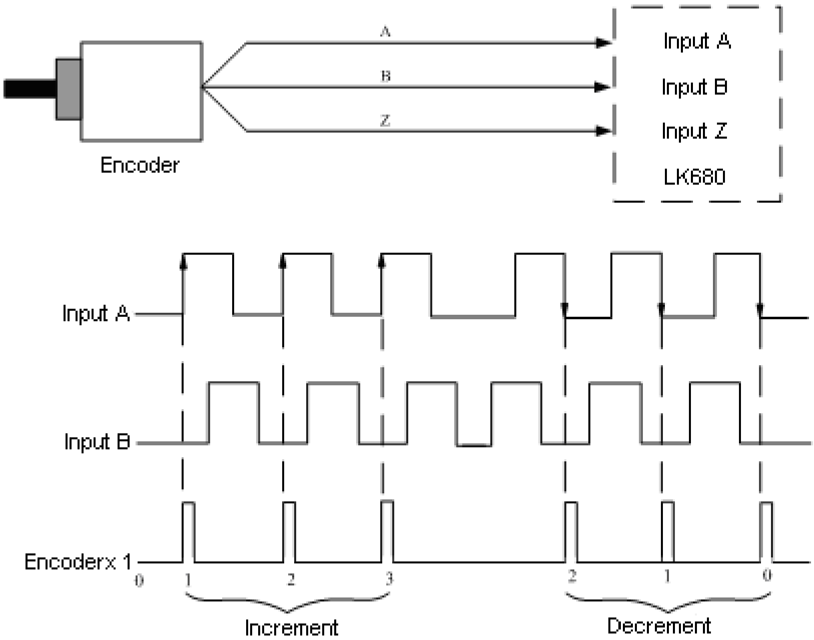


Figure 10.19: Encoder x 1 Mode of LK620

10.2.6 Encoder x 4 Mode

Under the Encoder x 4 Mode, the highest frequency allowed at inputs A and B is 250 KHz, and they should maintain a phase difference of 90°. Double edge counting is achieved using frequency doubling, where counting is done on both the rising and falling edges of the signals at both A and B.

When the signal at A is 90° ahead of B, the counter increments its count, and when the signal at B is 90° ahead of A, the counter decrement its count.

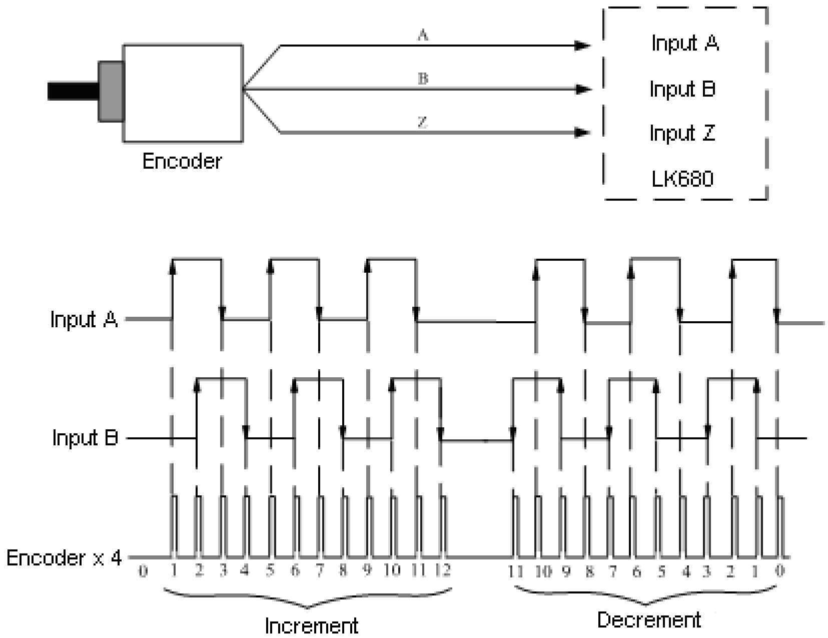


Figure 10.20: Encoder x 4 Mode of LK620

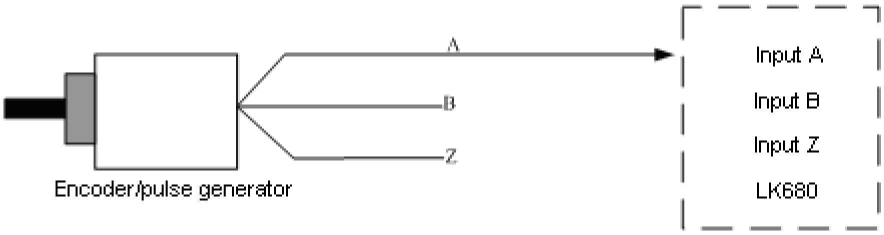
10.2.7 Frequency Measuring Mode

Under the frequency measuring mode, A is the input frequency signal (B and Z) are not used. The counter record the number pulses in the frequency signal at A in a given measuring period, and reports it as the

current count to the controller. In the configuration, the pulse frequency is computed using frequency count and measuring period. The measuring period is specified by the user. With 10ms as the base time unit, the parameters "Counter1ScalerValue" and "Counter2ScalerValue" represents how many base time units there are in the measuring period.

For example, if "Counter1ScalerValue" is set to 4, the measuring period of counter 1 will be 4x10ms = 40ms. Assuming that 3 pulses are received by counter 1 in the measuring period of 40ms, a division is computed in the configuration to obtain the pulse frequency as 3/40ms = 75Hz.

The measuring period can be set up to a maximum of 20s. Correspondingly, the maximum value for parameters "Counter1ScalerValue" and "Counter2ScalerValue" is 2000. The measuring period should not be set to 0. Under the frequency measuring mode, the highest measurable frequency is 1MHz, and the lowest measurable frequency is 0.1Hz.



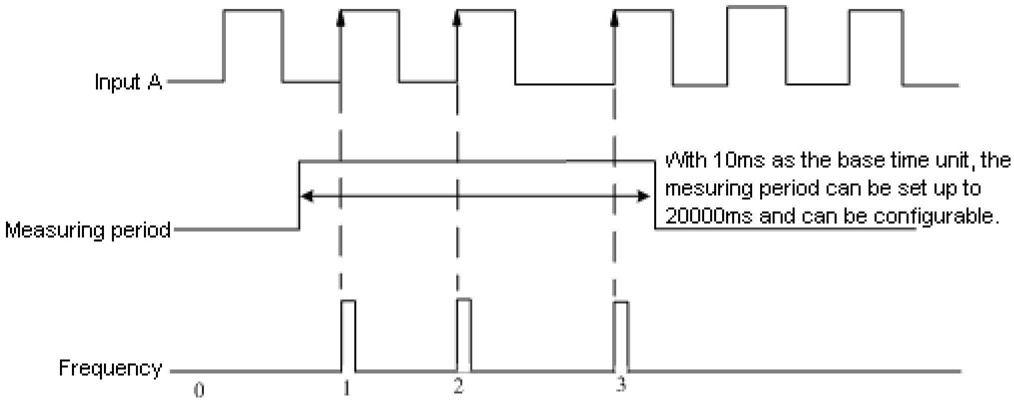
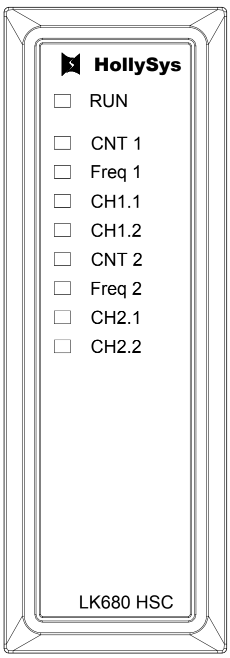


Figure 10.21: Frequency measuring mode of LK620

10.2.8 Indicators Definition

Indicator	Status	Definition
RUN	On	Module operates normally
	Flash	Communication not established or module is inhibited
	Off	Power Off or Module Failure
CH1.1	On	Counter 1 output channel 1 is on
	Off	Counter 1 output channel 1 is off
CH1.2	On	Counter 1 output channel 2 is on
	Off	Counter 1 output channel 2 is off
CNT1	On	Counter 1 in counter mode
Freq1	On	Counter 1 in frequency measuring mode
CH2.1	On	Counter 2 output channel 1 is on
	Off	Counter 2 output channel 1 is off
CH2.2	On	Counter 2 output channel 2 is on
	Off	Counter 2 output channel 2 is off
CNT2	On	Counter 2 in counter mode
Freq2	On	Counter 2 in frequency measuring mode

Table 10.9: Definition of LK620 Indicators



Specifications of RUN green light are as follows:

- After the power is on, the module waits for initialization data while the green light flashes with a frequency of 4 times per second.
- After the initialization is completed, the green light is constantly on to indicate the module in normal operation; if any error occurs in the initialization, then the communication is not established and the green light keeps flashing. Then, communication parameter settings shall be checked.
- Green light is constantly on in normal communications; green light flashes when communication breaks; green light returns to constant on when communication re-established.

10.2.9 Wiring Specifications

LK620 can be installed on the local and expansion backplane. The local backplanes support two types of wrings: terminal wiring and prefabricated cable wring.

Wiring to Backplane Terminals

LK620 module is connected to field signals through the correspondence terminals under the backplane installation slot. The relationship between each channel and terminal is shown in Table 10.16.

Signal Type		Counter 1		Counter 2	
		Definition of Signal	Terminal Number	Definition of Signal	Terminal Number
Input	A+	A2+	01	A1+	02
	A-	A2-	03	A1-	04
	B+	B2+	05	B1+	06
	B-	B2-	07	B1-	08
	Z+	Z2+	09	Z1+	10
	Z-	Z2-	11	Z1-	12
Output	First channel	OUT3	13	OUT1:	14
	Second channel	OUT4	15	OUT2	16
10~31.2VDC power supply	DC+	17			
	DC-	18			

Table 10.10: Definitions of LK620 Backplane Wiring Terminals

A1+/A1-, B1+/B1-, and Z1+/Z1- are the 3 inputs of counter 1. OUT1 and OUT2 are the 2 outputs of counter 1

A2+/A2-, B2+/B2-, and Z2+/Z2- are the 3 inputs of counter 2. OUT3 and OUT4 are the 2 outputs of counter 2.

In the wiring, the following shall be noted:

- Each counter provides two digital outputs.
- The module is connected to independent external 10~31.2VDC field power supply, which ensures the isolation of field and system.
- The 4 DO outputs share the same 10~31.2VDC field power supply.
- The output channels do not have reverse voltage protection. If there is an error in wiring, the internal circuitry may be burnt.
- The terminal "17" is connected to the positive of field power supply.
- Terminal "18" connects to the negative end of field power supply for the field power loss detection.
- A single terminal shall not be connected to many wires; therefore multiple-point connection can be established through bus bar or transferring terminal board.

In the following, we use three typical field devices as examples to describe the wiring method of LK620. Required input signal voltage difference range: 10~26.4V. That is, for differential signals, (U+)-(U-) = 10~26.4V, and for single end signals, U = 10~26.4V. The voltage range for DC power supplies connected to output channels: 10~31.2VDC.

Connection with incremental encoders

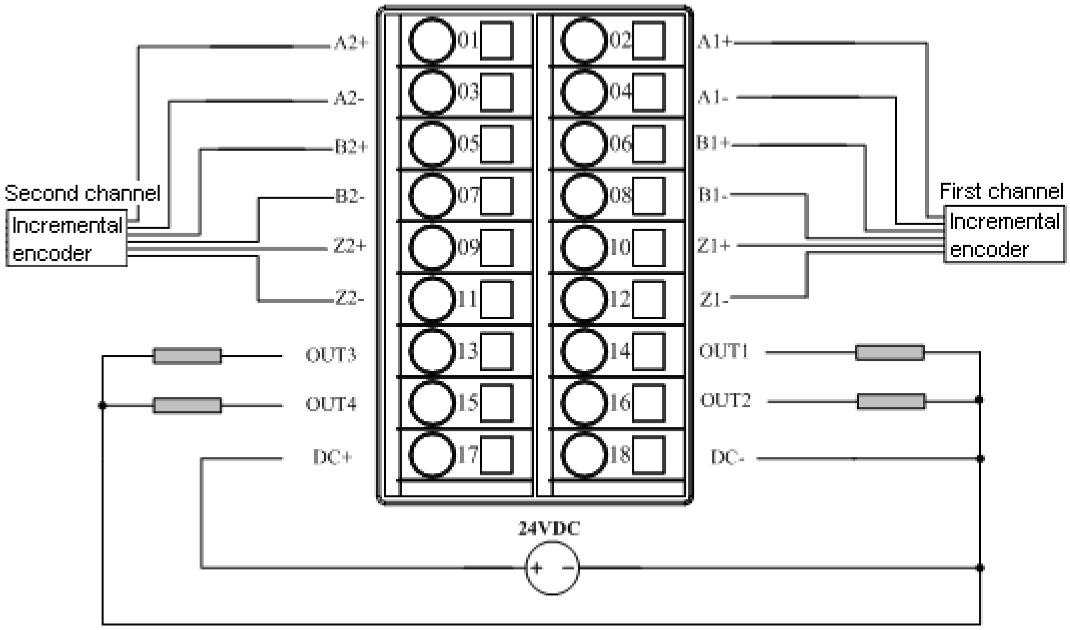


Figure 10.22: Connection of LK620 with incremental encoders

As shown in Figure 10.57, the correspondence between the outputs of incremental encoder and inputs of LK620 is: A—A; B—B; 0—Z.

Connection with photoelectric sensors

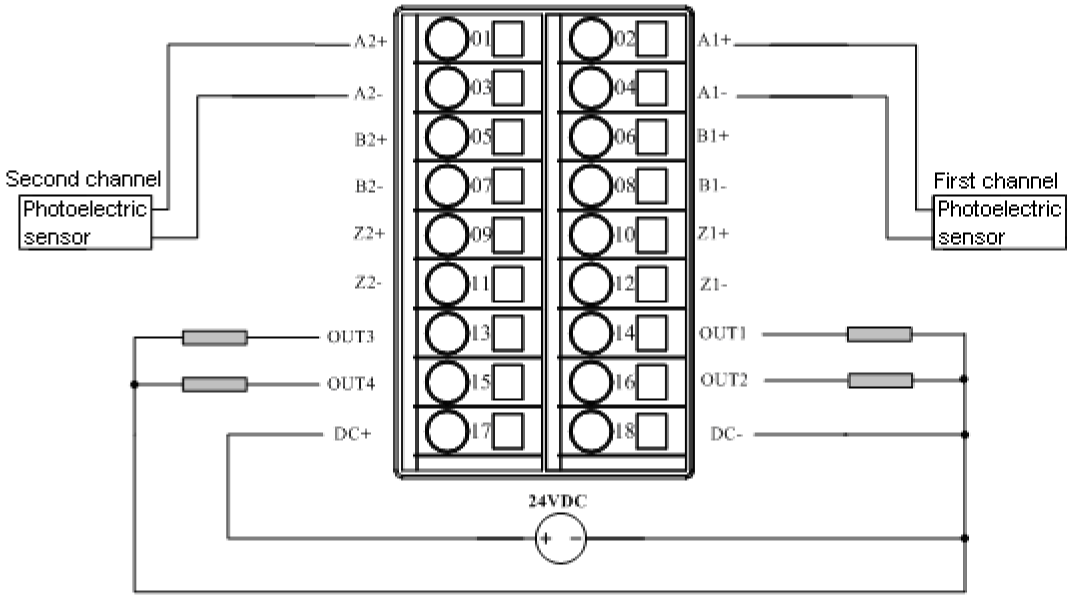


Figure 10.23: Connection of LK620 with photoelectric sensors

As shown in Figure 10.58, the outputs of photoelectric sensor are connected to the A and Z inputs of LK620 module, and B is open.

Connection with proximity sensors

As shown in Figure 10.59, the output of proximity sensor is connected to input A of LK620 module, and B and Z are open.

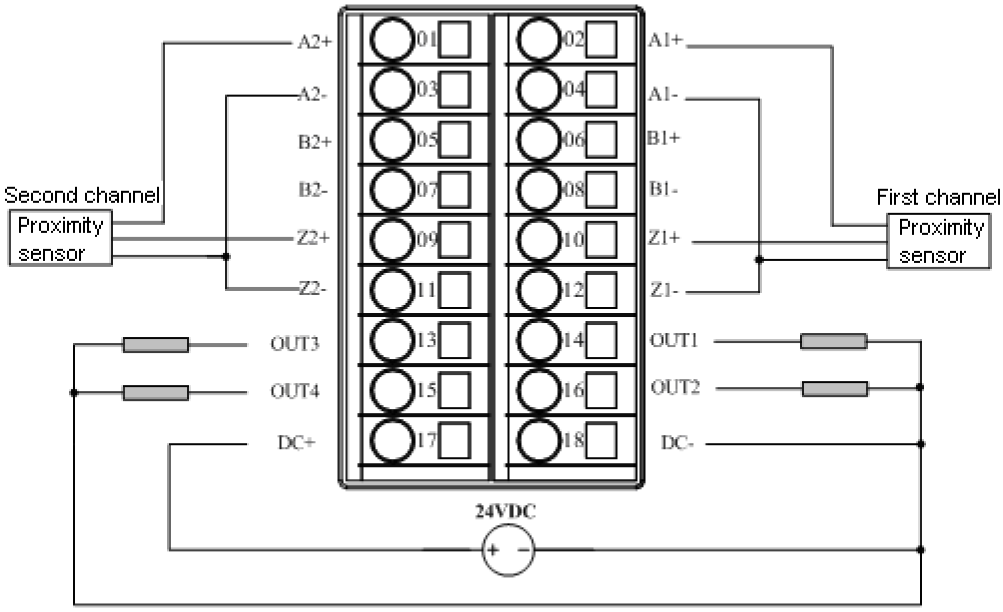


Figure 10.24: Connection of LK620 with proximity sensors

10.2.10 Wiring to Terminal Modules

Please refer to the information found on Chapter 12: Terminal Module.

10.2.11 Diagnosis Specifications

PowerPro Configuration

PowerPro V4 configuration software uses an external diagnostic library to check and acquire various kinds of diagnosis information, such as whether the module parameters are setup correctly and whether the modules and its channels are operating normally. For the DP-slave station modules, the DP slave station expansion diagnosis function block (HS_DPSlaveALarm) shall be called to check the DP module at any address on the PROFIBUS-DP link, as shown in Figure 5.6.

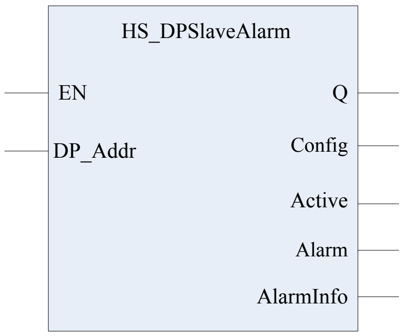


Figure 10.25: Expansion Diagnosis Function Block for DP Slave Station

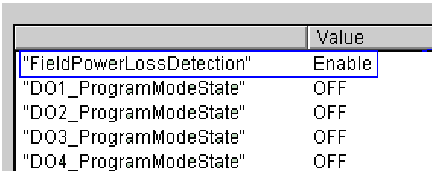
For more detailed usage on DP Expansion Diagnosis Function Block, please refer to LK Series PLC - Instruction Reference Manual. Please take note that the diagnosis library is an external library and it should be installed first in the Library Manager before usage.

The diagnostic information of DP-slave station modules can be classified to three different categories. All diagnosis data exist in the form of a structure block.

- **Device Diagnostic**: records of the overall diagnosis information of the module, such as the power-loss at the field power supply.
- **Identifier Diagnostic**: records of whether the module has diagnosis information.
- **Channel Diagnostic**: records of the channel level diagnosis information, such as open-wired and range exceeding.

Field Power Loss Detection

- LK620 provides function of field-side power supply loss detection. Whether to enable this function can be selected by user parameter "FieldPowerLossDetection", the default setting of which is "Enable". Parameter changes can only be effective after a full download.



	Value
"FieldPowerLossDetection"	Enable
"DO1_ProgramModeState"	OFF
"DO2_ProgramModeState"	OFF
"DO3_ProgramModeState"	OFF
"DO4_ProgramModeState"	OFF

Figure 10.26: Enable Selection of LK620 Power Loss Detection

- Reference to Figure 10.27, Terminal "17" connects to the positive of field power supply while terminal "18" connects to its negative. It carries out power loss detection by checking the changes of input voltage between these two terminals. In case of any failure, the failure status will be reported to the controller with the diagnosis data.

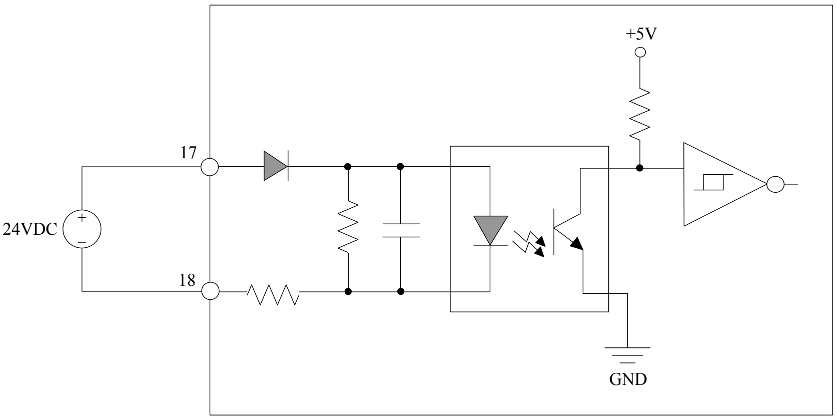


Figure 10.27: Field Power Loss Detection Circuitry

- When the field 24VDC power supply is lost (disconnected or power supply or voltage <5VDC), the device diagnosis data area of LK620 will generate diagnosis byte 0x04 (Bit2=1) and report it to the controller in the next scan period.
- When the field 24VDC power supply is recovered (power supply voltage 10~31.2VDC), the device diagnosis data area of LK620 will generate new diagnosis byte 0x00 (Bit2=0) and report it to the controller in the next scan period.
- LK620 module will only report the diagnosis data once respectively in the event of a power loss occurs or power loss recovered.

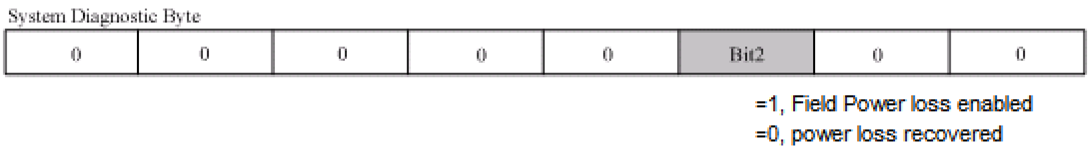


Figure 10.28: Device Diagnosis Byte of LK620 Module

Field power loss diagnosis is a device level diagnosis. After the DP slave station expansion diagnosis function block (HS_DPSlaveAlarm) is called, the device diagnosis data reported by LK620 will be stored in the corresponding fields of the output parameter "AlarmInfo" of "DevDiag.Data.Data[1], as shown in Table 6.2.

Diagnosis Information		Value	Definition
Device Diagnosis	ALarmInfo.DevDiag.Data.Data[1]	0X04	Field Power Loss
		0x00	Fault recovery or no diagnosis data

Table 10.11: Definition of LK620 Field Power Loss Detection

10.2.12 Function Specifications

Rollover value

- Under the counter mode, a rollover value needs to be set for the counter as the upper limit of the count. Valid values are in the range of 1~4,294,967,295.
- During counting, when the count equals to rollover value minus one, the counter will be reset to 0 and start counting again. If the rollover value is set to 1500, the counting sequence would be: … 1498, 1499, 0, 1, 2, …

- The rollover value of counter 1 is set using the parameter "Counter1_RolloverValue", and the rollover value of counter 2 is set using the parameter "Counter2_RolloverValue".
- The roll flag (Counter_Rolled) indicates whether the counter has reached the rollover value and has rolled over. If counter 1 has rolled over, the parameter "Counter1_Rolled" = 0x01. If the counter has not rolled or the flag has been cleared, "Counter1_Rolled" = 0x00.
- The user may clear the roll flag using the clear roll flag parameter (Counter_ClearRolledFlag), so as to record the next rollover.
- Under the frequency measuring mode, the rollover value should be set to 0.

Preset value

- Under counter mode, a preset value can be set for the counter. When the counter is powered on or restarted, the counter will start counting from the preset value. Valid range for preset values is 0~4,294,967,295. Under the frequency measuring mode, the preset value is not used.
- The preset value must be less than the rollover value. If it is greater than the rollover value, the count will be wrong.
- It is worth noting that, when the count reaches the rollover value, the counter will roll over to 0, and start counting from 0, not the preset value, as shown in Figure 10.63.

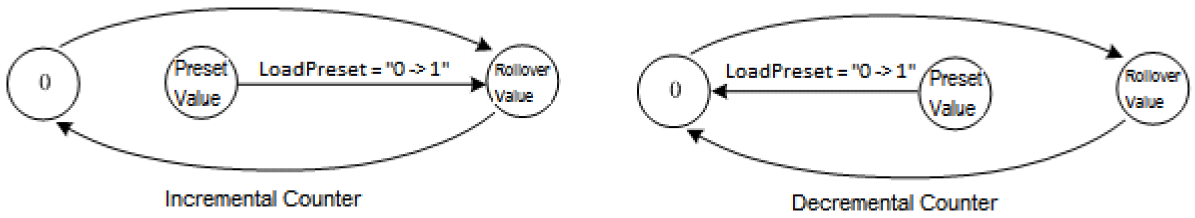


Figure 10.29: Preset value and rollover value of LK620 counters

- The parameter "Counter_Reset" determines if the counter will be reset and start counting. When a rising edge signal (0->1) is written, the counter is reset and starts counting. The parameter "Counter_LoadPreset" determines a preset value will be loaded start counting from the preset value when the counter is reset. When a rising edge signal (0->1) is written, the counter will load the preset value and start counting from the preset value when the counter is reset. If a rising edge signal is written into parameter "Counter_Reset" but not in the parameter "Counter_LoadPreset", the counter will reset and start counting from 0.
- The preset value of counter 1 is set using the parameter "Counter1_PresetValue", and the preset value of counter 2 is set using the parameter "Counter2_PresetValue".

Frequency measuring period

- Under the frequency measuring mode, a time period has to be configured for the frequency measurement, which is called the measuring period. The counter will count the number of pulses received during the specified measuring period.
- The measuring period of the two counters can be set using parameters "Counter1_ScalerValue" and "Counter2_ScalerValue" respectively. The default value is 0, and range of valid values is 0~2000, which represents how many time units (10ms) there are in the measuring period. Example: When counter 1 is in frequency measuring mode, and parameter "Counter1_ScalerValue" = 6, the measuring period of counter 1 will be 6x10ms = 60ms. Suppose counter 1 received 6 pulses during the measuring period, the pulse frequency can be calculated as 6/60ms = 100Hz.
- If the counter is not in the frequency measuring mode, this parameter should be set to 0.
- The maximum allowed value for the parameter is 2000, which means that the longest measuring period will be 2000x10ms = 20s.

	Value
"FieldPowerLossDetection"	Enable
"DO1_ProgramModeState"	OFF
"DO2_ProgramModeState"	OFF
"DO3_ProgramModeState"	OFF
"DO4_ProgramModeState"	OFF
"DO1_FaultModeState"	OFF
"DO2_FaultModeState"	OFF
"DO3_FaultModeState"	OFF
"DO4_FaultModeState"	OFF
"Counter1_Inhibit"	Disable
"Counter1_OperationalMode"	Counter Mode
"Counter1_ScalerValue"	0
"Counter1_StorageMode"	Store/Continue
"Counter1_Z_Invert"	Disable
"Counter1_InputA_Filter"	No Filter
"Counter1_InputB_Filter"	No Filter
"Counter1_InputZ_Filter"	No Filter
"Counter2_Inhibit"	Disable
"Counter2_OperationalMode"	Counter Mode
"Counter2_ScalerValue"	0
"Counter2_StorageMode"	Store/Continue
"Counter2_Z_Invert"	Disable
"Counter2_InputA_Filter"	No Filter
"Counter2_InputB_Filter"	No Filter
"Counter2_InputZ_Filter"	No Filter

Figure 10.30: LK620 counter measuring period settings

Output ON

- A count value can be set for each output, and when the current count of the counter reaches the value, the output channel outputs ON (that is, the channel is closed). This value is called the output ON value (Output_ON_Value).
- The output ON values for all output points (OUT1/OUT2/OUT3/OUT4) are determined by parameters "Output1_ON_Value", "Output2_ON_Value", "Output3_ON_Value" and "Output4_ON_Value" respectively, which are double word (DWORD) variables with the range 0~4,294,967,295.
- The output ON value should be less than the rollover value. If the output ON value is greater than or equal to the rollover value, the count will not be able to reach the output ON value, and the output channel will not output ON.
- The user parameter "Output Control" can be used to directly control the states of each output point of the counter. For example, if the current output of the output channel 1 (OUT1) is modified to be "ON" by using "Output1Control", the channel will be forced to be closed, regardless whether the current count in counter 1 has reached the output ON value (Ouput1_ON_Value), and the output channel 1 will output and stay at the "ON" state.
- Only when the parameter "Output Control" is set to "Output according to count", the output channel will output ON only when the output ON value is reached.

Output OFF

- Just after power on, output channels remain in the initial state and output OFF. After output is enabled, it will output states configured in the user program. When the module is reset, the output channel will output OFF. After communication is established and parameters re-downloaded, it will output states configured in the user program.
- A count value can be set for each output, and when the current count of the counter reaches the value, the output channel outputs OFF (that is, the channel is open and the output stopped). This value is called the output OFF value (Output_OFF_Value).
- The output OFF value should be less than the rollover value. If the output OFF value is greater than or equal to the rollover value, it will output OFF when the counter rolls over. That is, when the count = (rollover value – 1), the output channel will output OFF, and the counter will roll back to 0 and restart counting.
- The output OFF values for all output points (OUT1/OUT2/OUT3/OUT4) are determined by parameters "Output1_OFF_Value", "Output2_OFF_Value", "Output3_OFF_Value" and "Output4_OFF_Value" respectively, which are double word (DWORD) variables with the range 0~4,294,967,295.
- The user parameter "Output Control" can be used to directly control the states of each output point of the counter. For example, if the current output of the output channel 1 (OUT1) is modified to be "OFF" by using "Output1Control", the channel will be forced to be open, regardless whether the current count in counter 1 has reached the output OFF value (Ouput1_OFF_Value), and the output channel 1 will output and stay at the "OFF" state.
- Only when the parameter "Output Control" is set to "Output according to count", the output channel will output OFF only when the output OFF value is reached.
- When the output OFF value = output ON value, OFF will be output.
- Take the first output point OUT1 of counter 1 for example, if "Output1Control" = 0x00 (output according to count), "Output1_ON_Value" = 3000, "Output1_OFF_Value" = 8000, the output state of the output point OUT1 will be as shown in Figure 10.67. If "Output1Control" = 0x02 (modify output value of OUT1 to OFF) or = 0x03 (modify output

value of OUT1 to ON), "Output1_ON_Value" = 3000, "Output1_OFF_Value" – 8000, the output state of the output point OUT1 will be as shown in Figure 10.68.

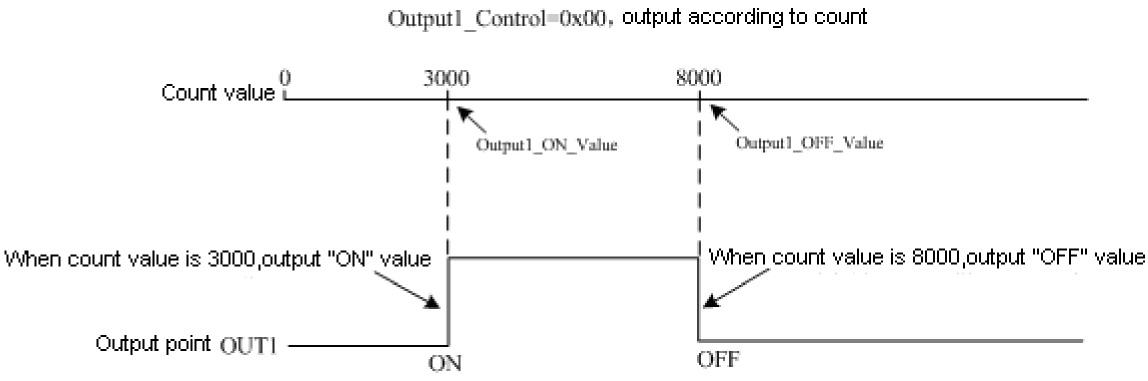


Figure 10.31: Sequence diagram of output OUT1 according to count

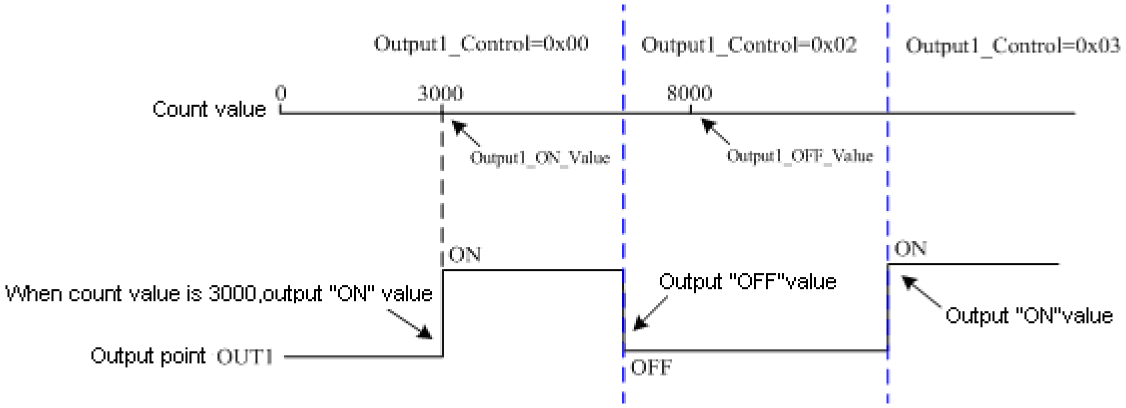


Figure 10.32: Sequence diagram of output OUT1 after output is forcedly modified

Store count

- When Z signal (by default the rising edge is valid, and after "Z inversion" is enabled, the falling edge would be valid) arrives, the counter can store the current count, until the next Z signal arrives, after which the old count will be overwritten by the new count.
- Whether counter 1 and counter 2 store counts, and which storage mode to use are determined by the parameters "Counter1StorageMode" and "Counter2StorageMode". The default value is "Store/Continue" (store the value and continue counting). In the following we describe the counting of the counter under different storage modes.
- Choosing a storage mode will enable the store count function, and will determine how the counter will store the current count when the Z signal arrives. Choosing "No Store Mode" (do not store counts) will deactivate the store count function.
- After the store count function is enabled, LK620 not only report the current count (Counter_PresentValue), but will also report the stored count (Counter_StoredValue).

	Value
"FieldPowerLossDetection"	Enable
"DO1_ProgramModeState"	OFF
"DO2_ProgramModeState"	OFF
"DO3_ProgramModeState"	OFF
"DO4_ProgramModeState"	OFF
"DO1_FaultModeState"	OFF
"DO2_FaultModeState"	OFF
"DO3_FaultModeState"	OFF
"DO4_FaultModeState"	OFF
"Counter1_Inhibit"	Disable
"Counter1_OperationalMode"	Counter Mode
"Counter1_ScalerValue"	0
"Counter1_StorageMode"	Store/Continue
"Counter1_Z_Invert"	Disable
"Counter1_InputA_Filter"	No Filter
"Counter1_InputB_Filter"	No Filter
"Counter1_InputZ_Filter"	No Filter
"Counter2_Inhibit"	Disable
"Counter2_OperationalMode"	Counter Mode
"Counter2_ScalerValue"	0
"Counter2_StorageMode"	Store/Continue
"Counter2_Z_Invert"	Disable
"Counter2_InputA_Filter"	No Filter
"Counter2_InputB_Filter"	No Filter
"Counter2_InputZ_Filter"	No Filter

Figure 10.33: LK620 storage mode settings

Storage mode

- When the counter stores count, there are 4 different storage modes:
- **Store/Continue (default)**: The counter stores the current count and continues counting.

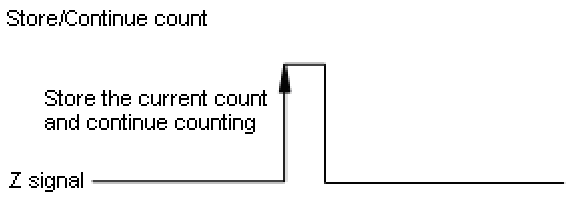


Figure 10.34: LK680 store/continue mode

- **Store/Wait/Resume**: After the counter stores the current count, the counting stops, and will resume when the falling edge of Z signal arrives.

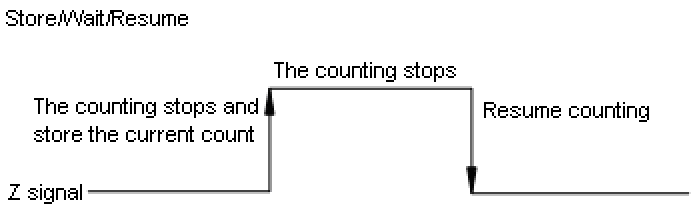


Figure 10.35: LK680 store/wait/resume mode

- **Store-Reset/Wait/Start**: After the counter stores the current count, the counting stops and the count is cleared. The counting will restart from 0 when the falling edge of Z signal arrives.

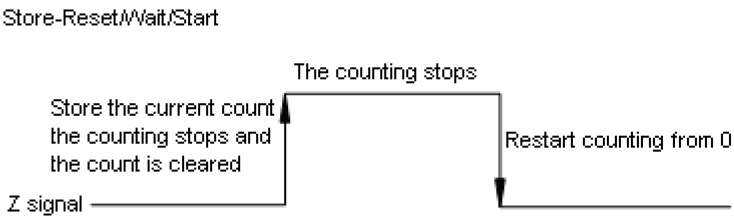


Figure 10.36: LK680 store-reset/wait/start mode

- **Store-Reset/Start**: The counter stores the current count, reset, and restarts counting from 0.

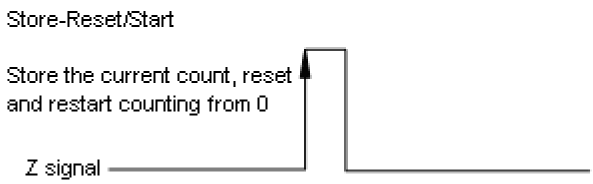


Figure 10.37: LK680 store-reset/start mode

Z signal inversion

- By default, the rising edge of the Z signal is valid. But after enabling the Z signal inversion function, the falling edge of the Z signal will be valid. That is, the falling edge of the Z signal will trigger interrupts, and the counter stores count when the falling edge of Z signal arrives.
- After enabling the Z signal inversion, the trigger conditions for storing counts will be changed to as shown in Figure 10.79.

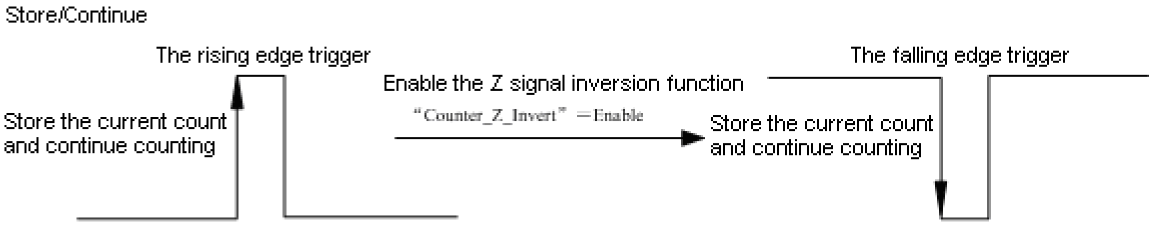
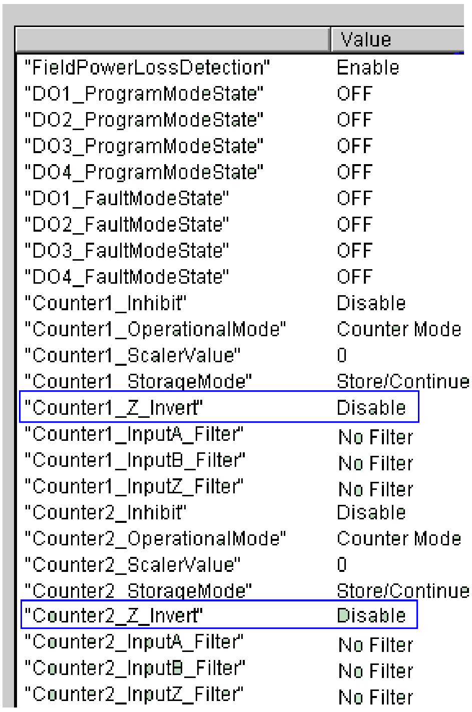


Figure 10.38: LK680 Z signal inversion

- Whether the Z signal of counter 1 is inversed is determined by the parameter "Counter1_Z_Invert", and whether the Z signal of counter 2 is inversed is determined by the parameter "Counter2_ZInvert". The default is not to invert (Disable).



	Value
"FieldPowerLossDetection"	Enable
"DO1_ProgramModeState"	OFF
"DO2_ProgramModeState"	OFF
"DO3_ProgramModeState"	OFF
"DO4_ProgramModeState"	OFF
"DO1_FaultModeState"	OFF
"DO2_FaultModeState"	OFF
"DO3_FaultModeState"	OFF
"DO4_FaultModeState"	OFF
"Counter1_Inhibit"	Disable
"Counter1_OperationalMode"	Counter Mode
"Counter1_ScalerValue"	0
"Counter1_StorageMode"	Store/Continue
"Counter1_Z_Invert"	Disable
"Counter1_InputA_Filter"	No Filter
"Counter1_InputB_Filter"	No Filter
"Counter1_InputZ_Filter"	No Filter
"Counter2_Inhibit"	Disable
"Counter2_OperationalMode"	Counter Mode
"Counter2_ScalerValue"	0
"Counter2_StorageMode"	Store/Continue
"Counter2_Z_Invert"	Disable
"Counter2_InputA_Filter"	No Filter
"Counter2_InputB_Filter"	No Filter
"Counter2_InputZ_Filter"	No Filter

Figure 10.39: LK620 Z signal inversion enabling

Input filter

- Provides 460KHz, 230KHz, 115KHz, 57KHz, 28KHz Input filtering.
- When the input signal is not a standard pulse signal, input filter can be enabled to filter A, B and Z signals respectively. Whether filters are enabled for the 3 input signals for counter 1 and counter 2 is determined by parameters "Counter1_InputA/B/Z_Filter" and "Counter2_InputA/B/Z_Filter". The default is not to enable.

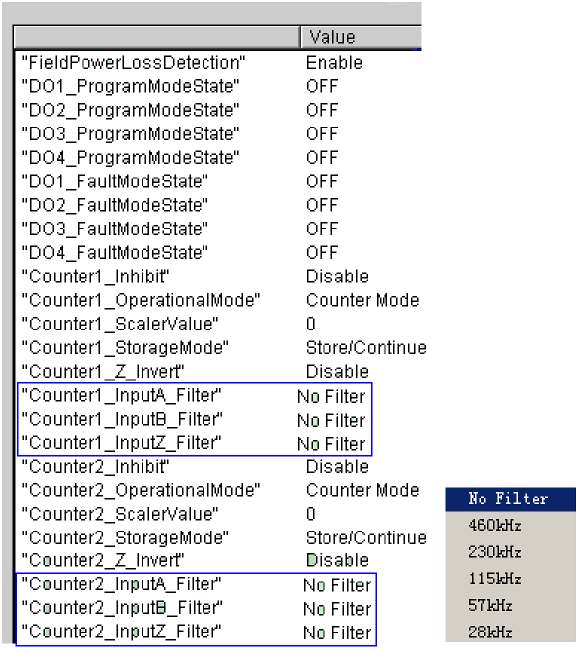


Figure 10.40: LK620 input filter enabling

Enable Output

- After the output module is power on, if it does not receive any output instruction from the controller, it will keep the initial status and does no output. The output of an initial status module is disabled. In this case, the module will keep this initial status even it enters programming mode or fault mode.
- After the operation of user programs, the controller sends output instruction to the output module through PROFIBUS-DP bus. Output module receives instruction and outputs data. The output of a slave module is enable once the module outputs an instruction sent by the controller. When the module output is enable, in case the module enters programming mode or fault mode, it will output values of programming mode or fault mode.
- In short, whether the module output is enabled will effect its output status under fault mode and programming mode.
- If the module is hot-swamped or turned on again after power loss after its output is enable, it will return back to the initial status and the output is disabled again. The output will be enabled again once the module receive another output instruction from the controller.
- After a full-download, the user program in the controller stops operation and the slave module enters programming mode automatically. In this case, if the module output is enabled before the download, it will output the programming mode value; if the module output is disabled before the download, it will keep the initial status.
- After the full-download, the user program operation can be executed through the following two methods:
  - Turn the key switch on controller front-panel to “RUN”.
  - Turn the key switch on controller front-panel to “REM” and execute “Operation” command in the programming software.

Communication Failure

- In normal communication, LK620 exchanges data with the controller through PROFIBUS-DP, each output points of the module (OUT1/ OUT2/ OUT3/ OUT4) outputs data according to the control command sent by the controller.
- When communication failure occurs, and the communication with the controller breaks, the “RUN” light flashes. In this case, output channel outputs a state (ON, OFF or counter result) preset in the configuration, known as the Fault Mode State. After the failure recovered, the module receives and executes the output command from the controller again with the “RUN” light constantly on.
- LK620 module may be in one of the following states in communication failure:
  - After power on, module cannot establish communication with the controller, then each output points (OUT1/ OUT2/ OUT3/ OUT4) of the module will retain the initial status and the output is not enabled.
  - Module in operation when communication failure (offline) occurs: each output point outputs fault mode state, counter keeps counting. After parameters are downloaded again, the counter is reset to 0.
  - Module in program mode when communication failure occurs: each output point outputs fault mode state. When failure is recovered, module returns to program mode.
  - If the module output has not been enabled, the module does not output fault mode state even if any communication failure occurs.
  - Fault mode state is configured by user parameter “FaultModeState”, and the default is to output OFF (open).

	Value
"FieldPowerLossDetection"	Enable
"DO1_ProgramModeState"	OFF
"DO2_ProgramModeState"	OFF
"DO3_ProgramModeState"	OFF
"DO4_ProgramModeState"	OFF
"DO1_FaultModeState"	OFF
"DO2_FaultModeState"	OFF
"DO3_FaultModeState"	OFF
"DO4_FaultModeState"	OFF
"Counter1_Inhibit"	Disable

Figure 10.41: Fault Mode State of LK620 Output Points

Program Mode

- Programming mode allows the user to modify, edit and download user programs into the controller. In programming mode, user programs are halted and cannot be restarted through programming software. The output channels keeps counting but do not upload the data; output channels are also not under control when they output a state (ON, OFF or counter result) preset in the configuration, known as the Program Mode State. Modifications on the state can only be effective after the full program download into the controller.
- Controller can make the slave station enter or exit program mode through the following methods:
  - Turn the key switch to “PRG” to force all modules into programming mode. At this moment, controller does not run any user program and the output channels of LK620 are not under controlled. Each output points (OUT1/ OUT2/ OUT3/ OUT4) outputs program mode state.
- Turn the key switch to “RUN”, module exits program mode and controller runs the user program.

Please note the if the module has never been output enabled, it does not output programming mode value even it enters programming mode.

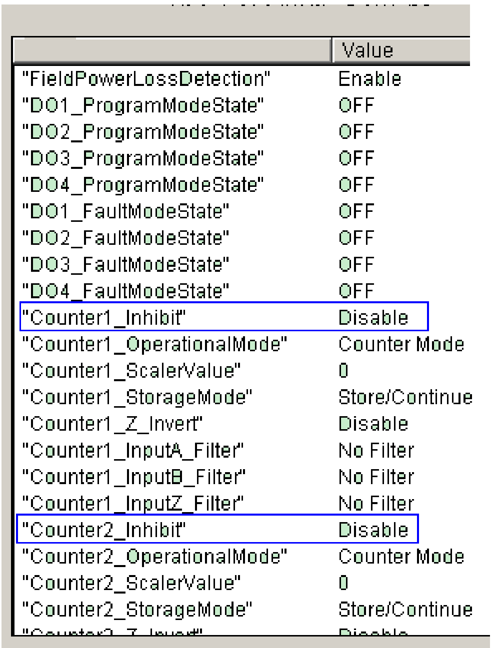
- After the full-download of user program, module automatically enters program mode no matter whether the key switch on the controller is located at “PRG”. If the output channels have never output any data before the download (i.e., output is not enabled), they will retain the initial status and do not output. If the output of output channel has been enabled before the download, the module outputs program mode state.
- Program mode state is configured by user parameter “ProgramModeState”, default output is OFF (open).
- Modifications will only be effective after the full download. Special notes shall be taken that: after the full down and before the operation, the module is under programming mode and outputs previous programming mode value. The new value will only replace the previous one after the operation of user program.

	Value
"FieldPowerLossDetection"	Enable
"DO1_ProgramModeState"	OFF
"DO2_ProgramModeState"	OFF
"DO3_ProgramModeState"	OFF
"DO4_ProgramModeState"	OFF
"DO1_FaultModeState"	OFF
"DO2_FaultModeState"	OFF
"DO3_FaultModeState"	OFF
"DO4_FaultModeState"	OFF

Figure 10.42: Program Mode State of LK620 Output Points

Module Inhibition

- Inhibition function can also inhibit counter1 or counter 2 separately. When a counter is inhibited, it does not count any more and reports the counter value before the inhibition. Whether to inhibit counter1 is selected by parameter “Counter1_Inhibit” while the inhibition of counter2 is selected by parameter “Counter2_Inhibit”, the default setting is “Disable”. The inhibition of a single counter only inhibits the counter operation, but not affects the counter’s output channel.



	Value
"FieldPowerLossDetection"	Enable
"DO1_ProgramModeState"	OFF
"DO2_ProgramModeState"	OFF
"DO3_ProgramModeState"	OFF
"DO4_ProgramModeState"	OFF
"DO1_FaultModeState"	OFF
"DO2_FaultModeState"	OFF
"DO3_FaultModeState"	OFF
"DO4_FaultModeState"	OFF
"Counter1_Inhibit"	Disable
"Counter1_OperationalMode"	Counter Mode
"Counter1_ScalerValue"	0
"Counter1_StorageMode"	Store/Continue
"Counter1_Z_Invert"	Disable
"Counter1_InputA_Filter"	No Filter
"Counter1_InputB_Filter"	No Filter
"Counter1_InputZ_Filter"	No Filter
"Counter2_Inhibit"	Disable
"Counter2_OperationalMode"	Counter Mode
"Counter2_ScalerValue"	0
"Counter2_StorageMode"	Store/Continue

Figure 10.43: Module Inhibition Setting of LK620

10.2.13 Parameter Specifications

The controller can only read and write the I/O information regularly after it entered data exchange mode. Therefore, in order to provide correct parameter information in the initialization process, users shall first set the hardware parameters in the configuration software PowerPro V4.

After adding “LK620 Counter2x1MHz” in the “PROFIBUS-DP Master”, user can configure the hardware parameters of LK620.

Communication Parameters

- LK620 module supports PROFIBUS-DP slave mode. It communicates and exchanges data with the controller acting as DP master through PROFIBUS-DP. The slave station adopts a unique communication address, which is determined by the backplane number and the slot number of the LK620 module.
- To establish the communication with the controller, the correct communication address of the slave station needs to be configured in the LK620’s DP parameter field in the configuration software. Other communication parameters shall keep their default values.

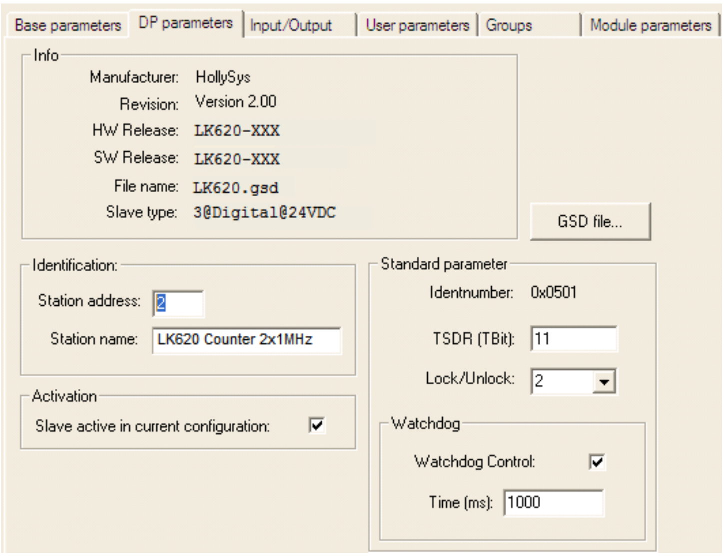


Figure 10.44: LK620 Communication Station Address Configuration

User Parameters

- User parameters are used to configure the module's operating mode. They are written into the controller during the download of user program and will not be read in every scanning circle. Each parameter has a default value that can be changed according to requirements of the project. User parameters do not support online modification; therefore they can only be effective after the full download.
- LK620 module has totally 21 bytes of user parameters. Please refer to for more details.

Module Parameters	Definition
FieldPowerLossDetection	Field power loss detection Enable or Disable = Enable, the function is enabled. (Default) =Disable, the function is disabled;
DO1_ProgramModeState DO2_ProgramModeState DO3_ProgramModeState DO4_ProgramModeState	DO1 to DO4 program mode state value = OFF, Output is disabled (Default) = ON, Output is enable = Depend on the counter value, output according to counter result.
DO1_FaultModeState DO2_FaultModeState DO3_FaultModeState DO4_FaultModeState	DO1 to DO4 fault mode state value = OFF, Output is disabled (Default) = ON, Output is enable = Depend on the counter value, output according to counter result.
Counter1_Inhibit	Whether to inhibit counter1 =Disable, not inhibit counter1 (Default) =Enable, inhibit counter1
Counter1_OperationalMode	Counter1 operation mode =Counter Mode (Default) =Encoder x 1 Mode =Encoder x 4 Mode =Frequency Mode, frequency measuring mode
Counter1_ScalerValue	Frequency measuring time of counter1, value range from 0 to 2000, 10ms as a single measurement unit. When value =0, frequency measuring mode is disabled. (Default)
Counter1_StorageMode	Counter1 storage mode =Store/Continue, store/continue counting =Store/Wait/Resume, store/wait/resume counting =Store-Reset/Wait/Start, store/wait/reset counting =Store-Reset/Start, store/reset counting =No Store Mode, Storage mode not in used. Do not store counting value.
Counter1_Z_Invert	Enable counter 1 Z inversion =Disable, Z inversion function is disabled; (Default) =Enable, Z inversion function is enabled.
Counter1_InputA_Filter	Counter 1 Input A Filtering Configuration =No Filter (Default) =460KHz =230KHz =115KHz =57KHz =28KHz
Counter1_InputB_Filter	Counter 1 Input B Filtering Configuration =No Filter (Default) =460KHz =230KHz =115KHz =57KHz =28KHz
Counter1_InputZ_Filter	Counter 1 Input Z Filtering Configuration =No Filter (Default) =460KHz

	=230KHz =115KHz =57KHz =28KHz = Z signal INT, enable Z interrupt
Counter2_Inhibit	Whether to inhibit counter2 =Disable, not inhibit counter2 (Default) =Enable, inhibit counter2
Counter2_OperationalMode	Counter2 operation mode =Counter Mode (Default) =Encoder x 1 Mode =Encoder x 4 Mode =Frequency Mode, frequency measuring mode
Counter2_ScalerValue	Frequency measuring time of counter2, value range from 0 to 2000, 10ms as a single measurement unit. When value =0, frequency measuring mode is disabled. (Default)
Counter2_StorageMode	Counter2 storage mode =Store/Continue, store/continue counting =Store/Wait/Resume, store/wait/resume counting =Store-Reset/Wait/Start, store/wait/reset counting =Store-Reset/Start, store/reset counting =No Store Mode, Storage mode not in used. Do not store counting value.
Counter2_Z_Invert	Enable counter 2 Z inversion =Disable, Z inversion function is disabled; (Default) =Enable, Z inversion function is enabled.
Counter2_InputA_Filter	Counter 2 Input A Filtering Configuration =No Filter (Default) =460KHz =230KHz =115KHz =57KHz =28KHz
Counter2_InputB_Filter	Counter 2 Input B Filtering Configuration =No Filter (Default) =460KHz =230KHz =115KHz =57KHz =28KHz
Counter2_InputZ_Filter	Counter 2 Input Z Filtering Configuration =No Filter (Default) =460KHz =230KHz =115KHz =57KHz =28KHz = Z signal INT, enable Z interrupt

Table 10.12: List of LK620 Users Parameters

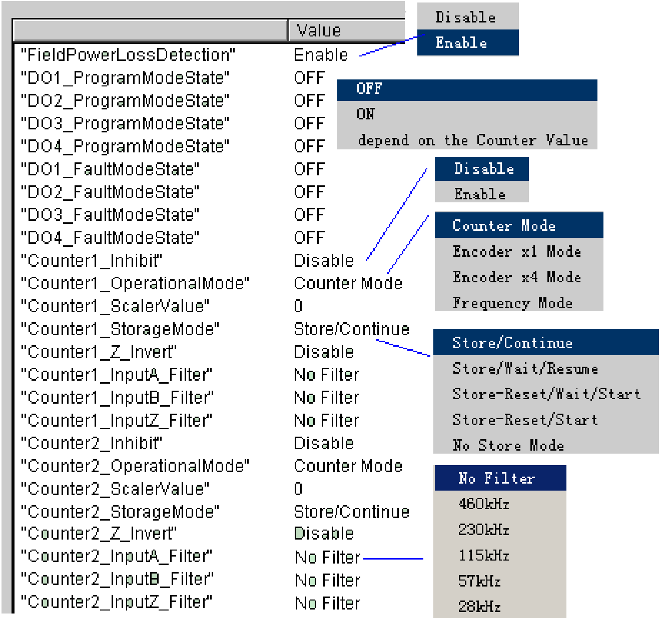


Figure 10.45: LK620 User Parameter Configuration Interface

10.2.14 Data Area Specifications

- Data area of each scan cycle of stored data should be updated in the user program in the form of a variable.
- LK620 Input data is uploaded to the controller's counter records; the data includes the current counter value, the storage value and output channel status read-back value.
- The output data from the controller is issued to the LK620's configuration parameters and control commands, including the preset value, rollover value, the output force control value, and the cleared roll flag value. During the user program execution, the input data and output data is updated once every scan cycle.

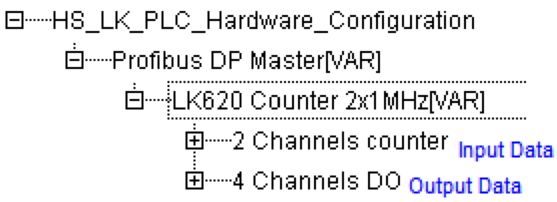


Figure 10.46: Input and Output Data Area of LK620

Input Data Specification

Input data uses 11 word (22 byte).

Data Type	Offset Address (Byte)	Data Name	Parameter Definition
DWORD	0 ~ 3	Counter1_PresentValue	The current count value of the counter1 (0~4,291,967,295)
DWORD	4 ~ 7	Counter1_StoredValue	The stored count value of counter1 (0~4,291,967,295)
DWORD	8 ~ 11	Counter2_PresentValue	The current count value of the counter2 (0~4,291,967,295)
DWORD	12 ~ 15	Counter2_StoredValue	The stored count value of the counter2 (0~4,291,967,295)
WORD	16	Output1to2_State	Bit0: The status of output1 =1, ON (channel closed) =0, OFF (channel opened) Bit1: The state of the output2 =1, ON(channel closed) =0, OFF (channel opened) Bit2~7 reserved
	17	Output3to4_State	Bit0: The status of output3 =1, ON (channel closed) =0, OFF (channel opened) Bit1: The state of the output4 =1, ON(channel closed)

			=0, OFF (channel opened) Bit2~7 reserved
WORD	18	Channel1_Z_State	Bit 0: Z state of Channel1 =0x00, low level =0x01, high level
	19	Channel2_Z_State	Bit 1: Z state of Channel2 =0x00, low level =0x01, high level
WORD	20	Counter1_Rolled	Whether counter1 reach rollover value and rolled =0x00, not rolled =0x01, rolled
	21	Counter2_Rolled	Whether counter2 reach rollover value and rolled =0x00, not rolled =0x01, rolled

Figure 10.47: LK620 - List of Input Data Specification

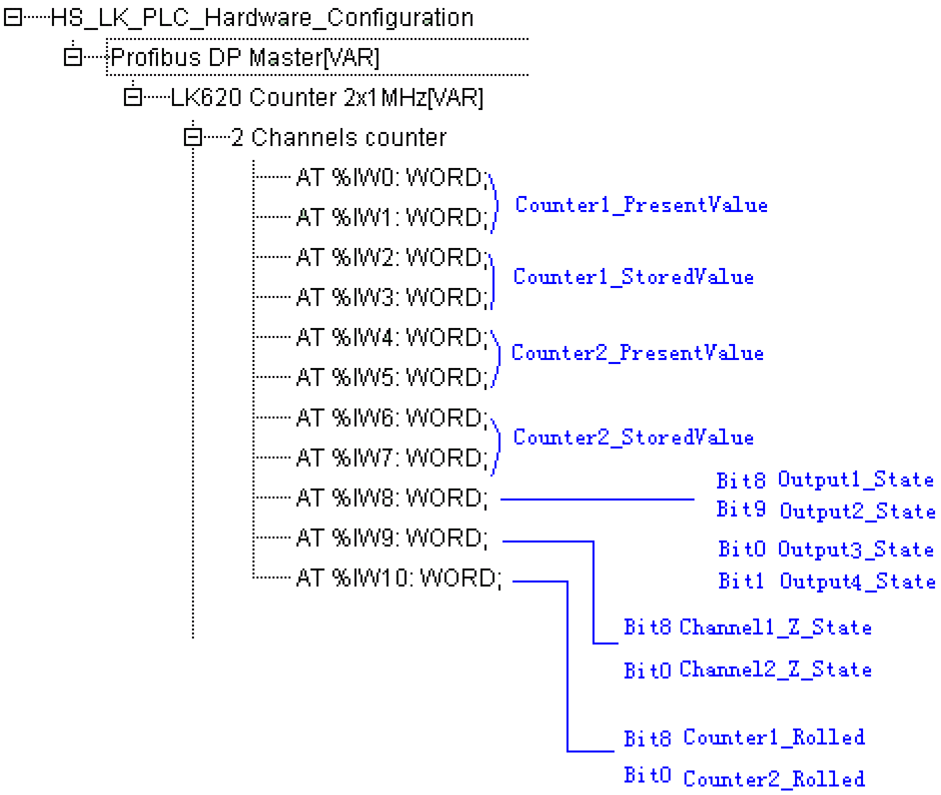


Figure 10.48: Input Data of LK620

Output Data Specification

Input data uses 11 words (22 byte).

Data Type	Offset Address (Byte)	Data Name	Parameter Definition
DWORD	0 ~ 3	Counter1_PresetValue	Preset value of counter1 (0~4,294,967,295), the value shall be smaller than the rollover value
DWORD	4 ~ 7	Counter1_RolloverValue	Rollover value of counter1 (0~4,294,967,295), in frequency measuring mode, rollover value is 0
WORD	8	Counter1_Reset	Counter1 reset and start counting 0x00—>0x01: reset counter1 and start counting from 0. Others: not reset
WORD	9	Counter1_LoadPreset	Whether counter1 load the preset value and start counting 0x00→0x01: load present value and start counting Others: no action

WORD	10	Output1_Control	Modification of output1output value =0x00, output according to count result =0x02, modify OUT0 output value to OFF =0x03, modify OUT0 output value to ON
	11	Output2_Control	Modification of output2 output value =0x00, output according to count result =0x02, modify OUT0 output value to OFF =0x03, modify OUT0 output value to ON
DWORD	12 ~ 15	Output1_ON_Value	Output1 output ON trigger value (0~4,294,967,295)
DWORD	16 ~ 19	Output1_OFF_Value	Output1 output OFF trigger value (0~4,294,967,295)
DWORD	20 ~ 23	Output2_ON_Value	Output2 output ON trigger value (0~4,294,967,295)
DWORD	24 ~ 27	Output2_OFF_Value	Output2 output OFF trigger value (0~4,294,967,295)
DWORD	28 ~ 31	Counter2_PresetValue	Preset value of counter2 (0~4,294,967,295), the value shall be smaller than the rollover value
DWORD	32 ~ 35	Counter2_RolloverValue	Rollover value of counter2 (0~4,294,967,295), in frequency measuring mode, rollover value is 0
WORD	36	Counter2_Reset	Counter2 reset and start counting 0x00—>0x01: reset counter2 and start counting from 0. Others: not reset
	37	Counter2_LoadPreset	Whether counter2 load the preset value and start counting 0x00→0x01: load present value and start counting Others: no action
WORD	38	Output3_Control	Modification of output3 output value =0x00, output according to count result =0x02, modify OUT0 output value to OFF =0x03, modify OUT0 output value to ON
	39	Output4_Control	Modification of output4 output value =0x00, output according to count result =0x02, modify OUT0 output value to OFF =0x03, modify OUT0 output value to ON
DWORD	40 ~ 43	Output3_ON_Value	Output3 output ON trigger value (0~4,294,967,295)
DWORD	44 ~ 47	Output3_OFF_Value	Output3 output OFF trigger value (0~4,294,967,295)
DWORD	48 ~ 51	Output4_ON_Value	Output4 output ON trigger value (0~4,294,967,295)
DWORD	52 ~ 55	Output4_OFF_Value	Output4 output OFF trigger value (0~4,294,967,295)
WORD	56	Counter1_ClearRolledFlag	Counter 1 clear rollover flag 0x00→0x01: clear rollover flag Others: no action
	57	Counter2_ClearRolledFlag	Counter 2 clear rollover flag 0x00→0x01: clear rollover flag Others: no action

Figure 10.49: LK620 - List of Output Data Specification

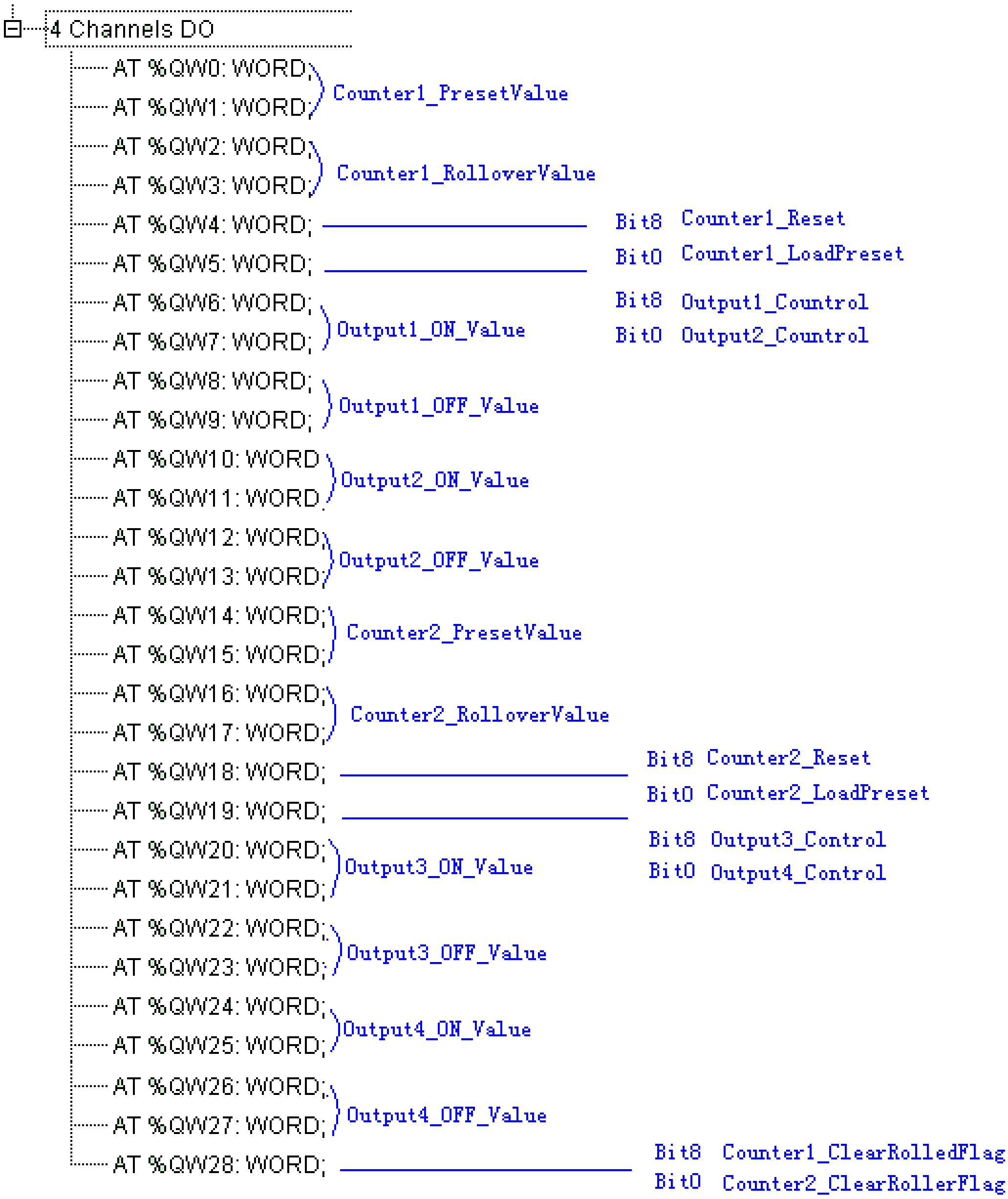


Figure 10.50: Output Data of LK620

10.2.15 Module Installation and Un-installation

Refer to chapter 1 on "Module Insertion Mechanical keys" and "Module Insertion and Removable" for more details.

10.2.16 Technical Specification

LK620 [24VDC 2-Channel Counter Module]	
System Power Supply	
Power Supply Voltage	24VDC (-10% ~ +10%)
Power Consumption	80mA@24VDC
Counter	
Number of counters	2
Counting range	0~4,294,967,295 (32bits)
Counting error	±1count code value
Counter input channels	3 channels of voltage pulse signals (A, B, Z) of each counter, total 6 channels of pulse input
Counter Output channels	2 channels of source MOSFET outputs of each counter, total 4-channel DO (OUT1~OUT4)

Counter Input (A1, B1, Z1, A2, B2, Z2)	
Pulse rated high level voltage	24VDC
Pulse high level (ON) voltage range	10~26.4VDC
Pulse high level input current range	2mA~7mA
Pulse low level (ON) voltage range	0~2VDC
Pulse low level (OFF) current leak	250μA max.
Max. Input Frequency	1MHZ (Not using input filter)
Counter Output (OUT1~OUT4)	
Output type	Source type
Output Voltage Range	10VDC~31.2VDC
Maximum output current	1.0A@10VDC~31.2VDC
Minimum load current	40mA per output channel
Maximum On-state Voltage Drop	550mV
Maximum OFF-state Current Leak	300μA per output channel
Output Delay Time OFF→ON ON→OFF	 20μs (normal), 50μs (maximum) 60μs (normal), 300μs (maximum)
Over-Current Protection	each channel has a separate self-recover fuse protection
Reverse Voltage Protection	None, output can be damaged if there is an incorrect wiring.
Isolation	
Input channel and System	500VAC@1min, Current Leak 5mA
Output channel and System	500VAC@1min, Current Leak 5mA
Failure Diagnosis and Hot swap	
Field-side Power Loss Detection	Field power loss: device diagnosis byte 0x04; power recovered: diagnosis byte 0x00
Hot Swap	Support
Communication Bus	
Protocol	HollySys proprietary protocol
Media	Communication bus is connected to the backplane through euro connector
Physical Features	
Mechanic Keys to Prevent Incorrect Insertion	F2
Installation	LK local backplane or expansion backplane
Dimensions	Width × Height × Depth = 35mm×100mm×100mm
Casing Protection Level	IEC60529 IP20
Weight	185g
Working Environment	
Working temperature	0℃~60℃
Working Relative Humidity	5%~95%, no condensate
Storage Temperature	-40℃~70℃
Storage Relative Humidity	5%~95%, no condensate

Table 10.13: Technical Specification of LK620 Module

10.3 LK680 24VDC 2-CHANNEL HIGH-SPEED COUNTER MODULE

10.3.1 Features

- 2-channel counters
- Bidirectional counting, frequency measurement
- Interrupt on match
- Z interrupt (encoder 0 bit interrupt)
- Z signal inversion
- Storing counter values
- Input filter
- Output channel readback
- Program mode output
- Fault Mode Output
- Module inhibition function
- Field Power Loss Detection
- System-to-Field Isolation
- Supports 32Mbps high-speed local bus
- Installed on local backplanes
- Supports hot swap

10.3.2 Operation Principles

The LK680 double channel high-speed counter module has two independent built-in counters, and each counter has three inputs (A, B and Z) and two digital outputs.

Input signal effective voltage range is 10~26.4VDC, and current range is 2.2mA(10VDC)~7mA(26.4VDC). One end of the load is connected to the negative of the field power supply, and the other end is connected to LK680. When the MOSFET electronic switch is closed, the current from the switch provides power to the load, and the 4 switches share the same power supply inside the module.

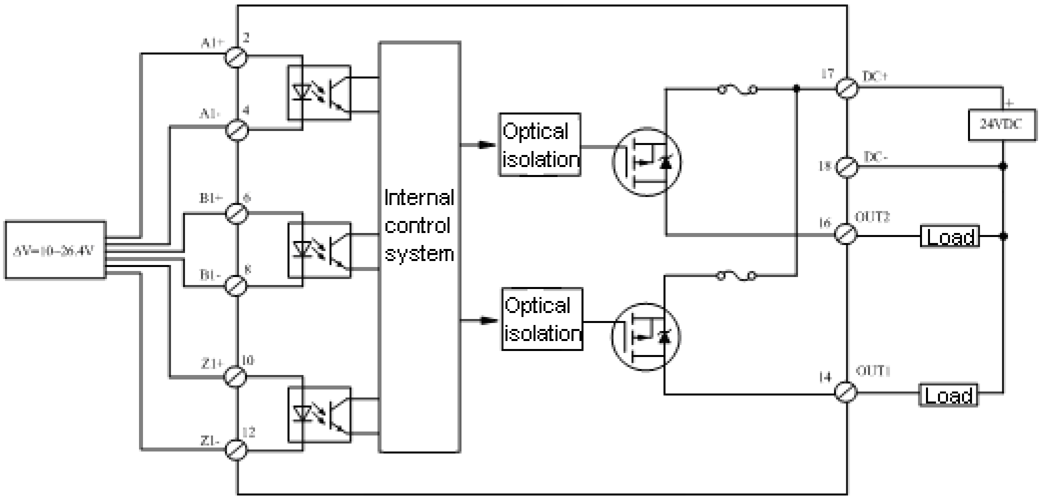


Figure 10.51: LK680 Channel Interface Circuit (Taking Counter 1 as Example)

10.3.3 Operation Modes

LK680 is mainly used to measure pulse inputs of photoelectric encoders and proximity sensors. There are four operation modes to choose from, namely, counter mode, encoder x 1 mode, encoder x 4 mode, and frequency measuring mode. Wherein, the frequency measuring mode can be used to measure frequencies in the range of 0.1Hz~1MHz.

The operation mode of counter 1 can be selected by the parameter "Counter1OperationalMode"; the operation mode of counter 2 can be selected by the parameter "Counter2OperationalMode", and the default setting for the parameters is Counter Mode.

Base parameters | Module parameters

Index	Name	Value
0	InhibitMode	Disable
1	FieldPowerLossDetection	Enable
2	ProgramModeState	0
3	FaultModeState	0
4	Counter1_Inhibit	Disable
5	Counter1_OperationalMode	Counter Mode
6	Counter1_ScalerValue	0
7	Counter1_StorageMode	Store/Continue
8	Counter1_Z_Invert	Disable
9	Counter1_FilterEnable	0
10	Counter1_Interrupt	No INT
11	Counter2_Inhibit	Disable
12	Counter2_OperationalMode	Counter Mode
13	Counter2_ScalerValue	0
14	Counter2_StorageMode	Store/Continue
15	Counter2_Z_Invert	Disable
16	Counter2_FilterEnable	0
17	Counter2_Interrupt	No INT

Figure 10.52: Choosing L680 operation modes

10.3.4 Counter Mode

Under the Counter Mode, A is the input pulse signal, where the highest allowed input signal frequency is 1MHz. B is the direction signal input. The counter starts counting on the rising edge of the signal at A, and the direction of counting is determined by the signal at B. When the level of the signal at B is low, the counter will increment its count, and when the level of the signal at B is high, the counter will decrement its count.

Input B	Counting direction
High level	Decrement
Low level (or open)	Increment

Table 10.14: LK680 counting directions under Counter Mode

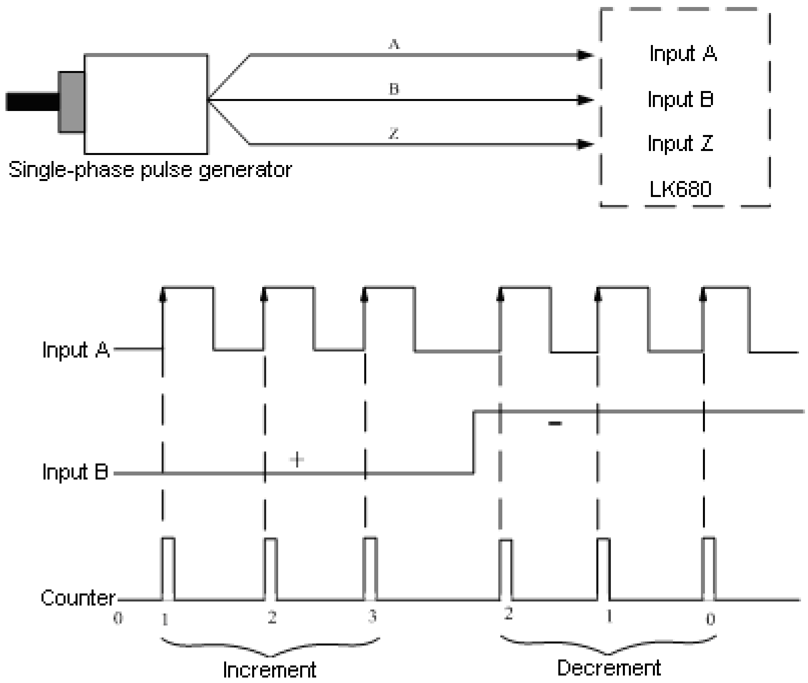


Figure 10.53: Counter mode of LK680.

10.3.5 Encoder x 1 Mode

Under the Encoder x 1 Mode, the highest frequency allowed at inputs A and B is 250 KHz, and they should maintain a phase difference of 90°. When A is 90° ahead of B, the counter increments its count, and starts counting on the rising edge of the signal at A. When B is 90° ahead of A, the counter decrements its count, and starts counting on the falling edge of the signal at A.

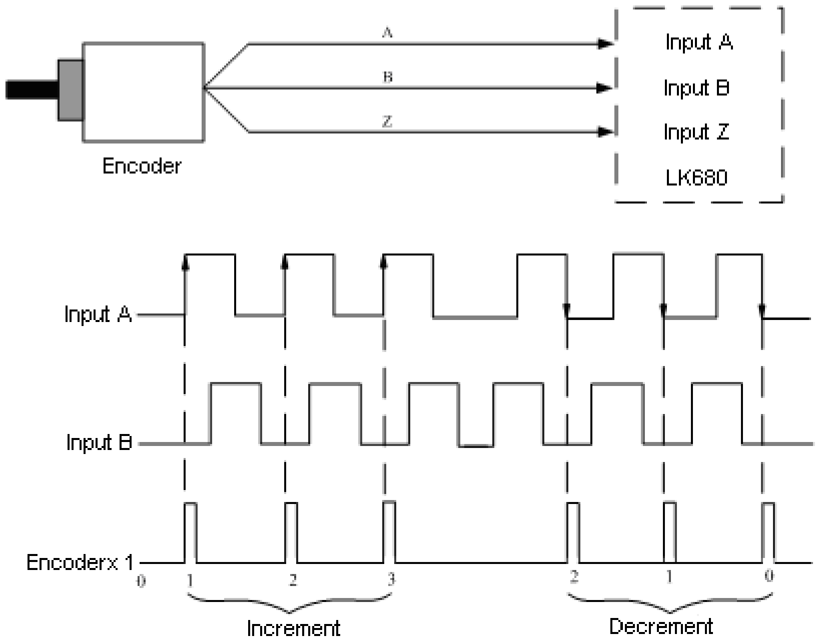


Figure 10.54: Encoder x 1 Mode of LK680

10.3.6 Encoder x 4 Mode

Under the Encoder x 4 Mode, the highest frequency allowed at inputs A and B is 250 KHz, and they should maintain a phase difference of 90°. Double edge counting is achieved using frequency doubling, where counting is done on both the rising and falling edges of the signals at both A and B.

When the signal at A is 90° ahead of B, the counter increments its count, and when the signal at B is 90° ahead of A, the counter decrement its count.

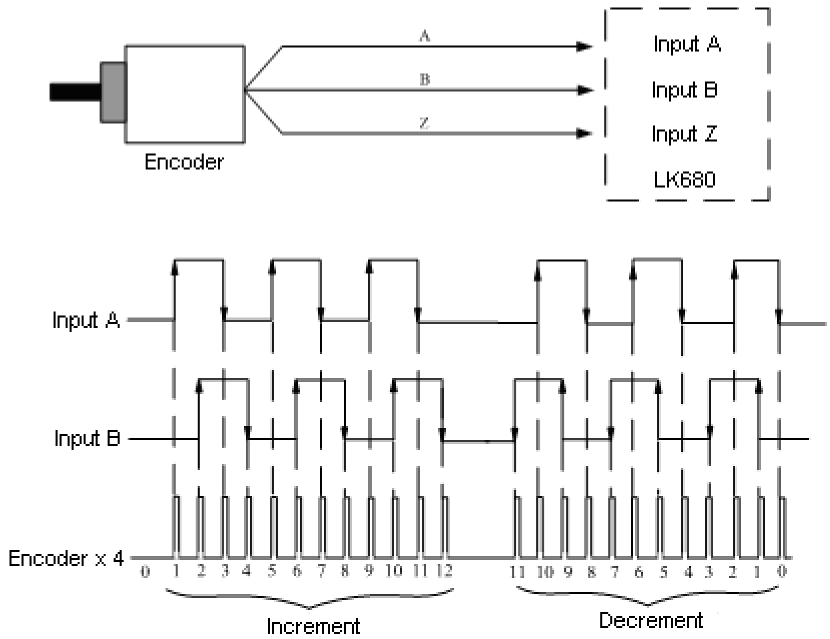


Figure 10.55: Encoder x 4 Mode of LK680

10.3.7 Frequency Measuring Mode

Under the frequency measuring mode, A is the input frequency signal, and B and Z are not used. The counter record the number pulses in the frequency signal at A in a given measuring period, and reports it as the current count to the controller. In the configuration, the pulse frequency is computed using frequency count and the measuring period.

The measuring period is specified by the user. With 10ms as the base time unit, the parameters "Counter1ScalerValue" and "Counter2ScalerValue" represents how many base time units there are in the measuring period. For example, if "Counter1ScalerValue" is set to 4, the measuring period of counter 1 will be 4x10ms = 40ms. Assuming that 3 pulses are received by counter 1 in the measuring period of 40ms, a division is computed in the configuration to obtain the pulse frequency as 3/40ms = 75Hz.

The measuring period can be set up to 20s. Correspondingly, the maximum value for parameters "Counter1ScalerValue" and "Counter2ScalerValue" is 2000. The measuring period should not be set to 0.

Under the frequency measuring mode, the highest measurable frequency is 1MHz, and the lowest measurable frequency is 0.1Hz.

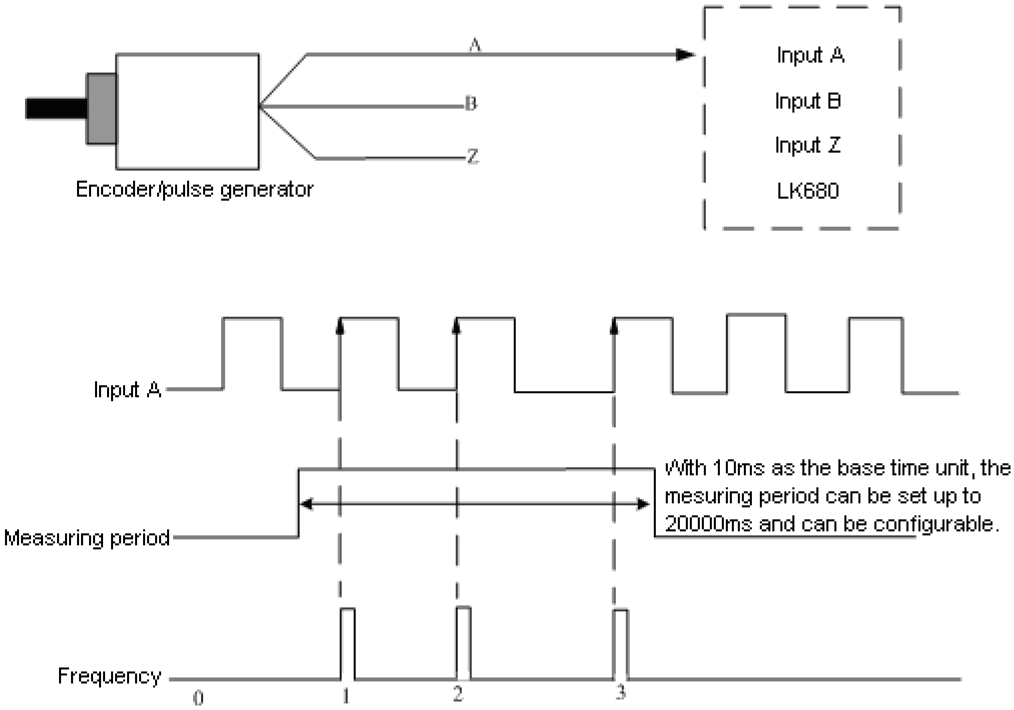
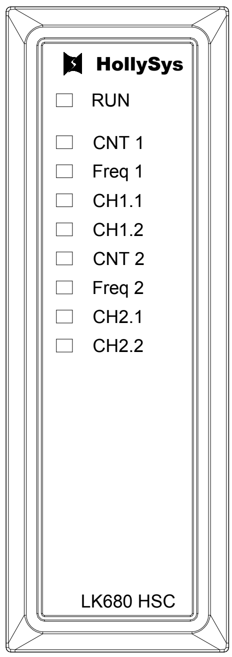


Figure 10.56: Frequency measuring mode of LK680

10.3.8 Indicators Definition

Indicator	Status	Definition
RUN	On	Module operates normally
	Flash	Communication not established or module is inhibited
	Off	Power Off or Module Failure
CH1.1	On	Counter 1 output channel 1 is on
	Off	Counter 1 output channel 1 is off
CH1.2	On	Counter 1 output channel 2 is on
	Off	Counter 1 output channel 2 is off
CNT1	On	Counter 1 in counter mode
Freq1	On	Counter 1 in frequency measuring mode
CH2.1	On	Counter 2 output channel 1 is on
	Off	Counter 2 output channel 1 is off
CH2.2	On	Counter 2 output channel 2 is on
	Off	Counter 2 output channel 2 is off
CNT2	On	Counter 2 in counter mode
Freq2	On	Counter 2 in frequency measuring mode

Table 10.15: Definition of LK680 Indicators



Specifications of RUN green light are as follows:

- After the power is on, the module waits for initialization data while the green light flashes with a frequency of 4 times per second.
- After the initialization is completed, the green light is constantly on to indicate the module in normal operation; if any error occurs in the initialization, then the communication is not established and the green light keeps flashing. Then, communication parameter settings shall be checked.
- Green light is constantly on in normal communications; green light flashes when communication breaks; green light returns to constant on when communication re-established.
- After LK680 is disabled, green light flashes at a frequency of 4 times / second.

10.3.9 Wiring Specifications

LK680 is a high-speed module, installed on local backplanes that support high-speed buses. The local backplanes support two types of wrings: terminal wiring and prefabricated cable wring.

Wiring to Backplane Terminals

LK680 module is connect to field signals through the correspondence terminals under the local backplane installation slot. The relationship between each channel and terminal is shown in Table 10.16.

Signal Type		Counter 1		Counter 2	
		Definition of Signal	Terminal Number	Definition of Signal	Terminal Number
Input	A+	A2+	01	A1+	02
	A-	A2-	03	A1-	04
	B+	B2+	05	B1+	06
	B-	B2-	07	B1-	08
	Z+	Z2+	09	Z1+	10
	Z-	Z2-	11	Z1-	12
Output	First channel	OUT3	13	OUT1:	14
	Second channel	OUT4	15	OUT2	16
10~31.2VDC power supply	DC+	17			
	DC-	18			

Table 10.16: Definitions of LK680 Backplane Wiring Terminals

A1+/A1-, B1+/B1-, and Z1+/Z1- are the 3 inputs of counter 1. OUT1 and OUT2 are the 2 outputs of counter 1. A2+/A2-, B2+/B2-, and Z2+/Z2- are the 3 inputs of counter 2. OUT3 and OUT4 are the 2 outputs of counter 2.

In the wiring, the following shall be noted:

- Each counter provides two digital outputs.
- The module is connected to independent external 10~31.2VDC field power supply, which ensures the isolation of field and system.
- The 4 DO outputs share the same 10~31.2VDC field power supply.
- The output channels do not have reverse voltage protection. If there is an error in wiring, the internal circuitry may be burnt.
- The terminal "17" is connected to the positive of field power supply.
- Terminal "18" connects to the negative end of field power supply for the field power loss detection.
- A single terminal shall not be connected to many wires; therefore multiple-point connection can be established through bus bar or transferring terminal board.
- In the following, we use three typical field devices as examples to describe the wiring method of LK680. Required input signal voltage difference range: 10~26.4V. That is, for differential signals, (U+)-(U-) = 10~26.4V, and for single end signals, U = 10~26.4V. The voltage range for DC power supplies connected to output channels: 10~31.2VDC.

Connection with incremental encoders

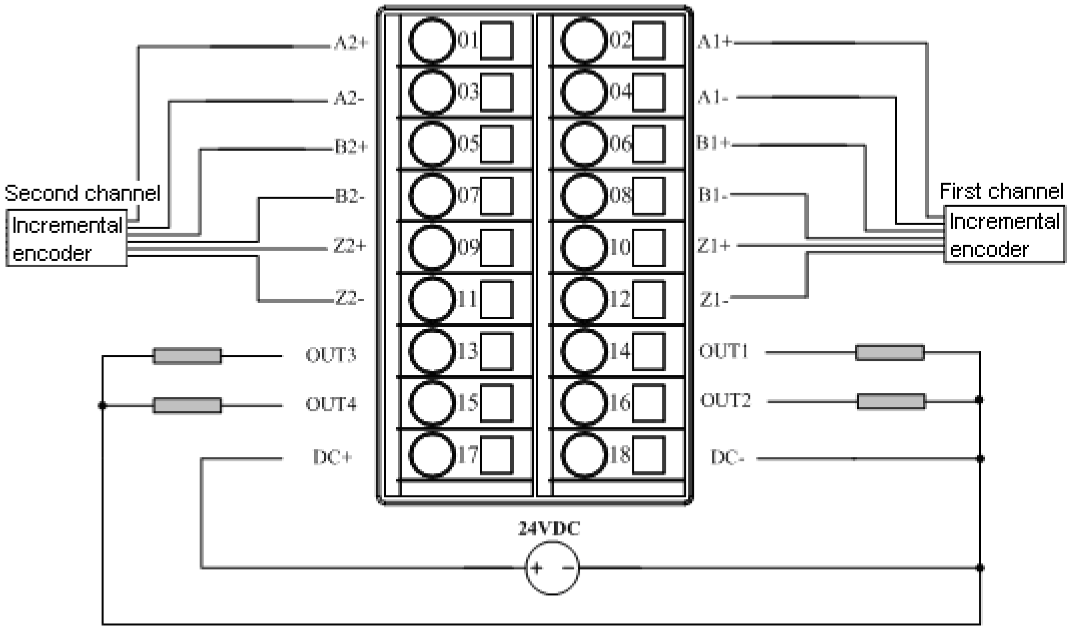


Figure 10.57: Connection of LK680 with incremental encoders

As shown in Figure 10.57, the correspondence between the outputs of incremental encoder and inputs of LK680 is: A—A; B—B; 0—Z.

Connection with photoelectric sensors

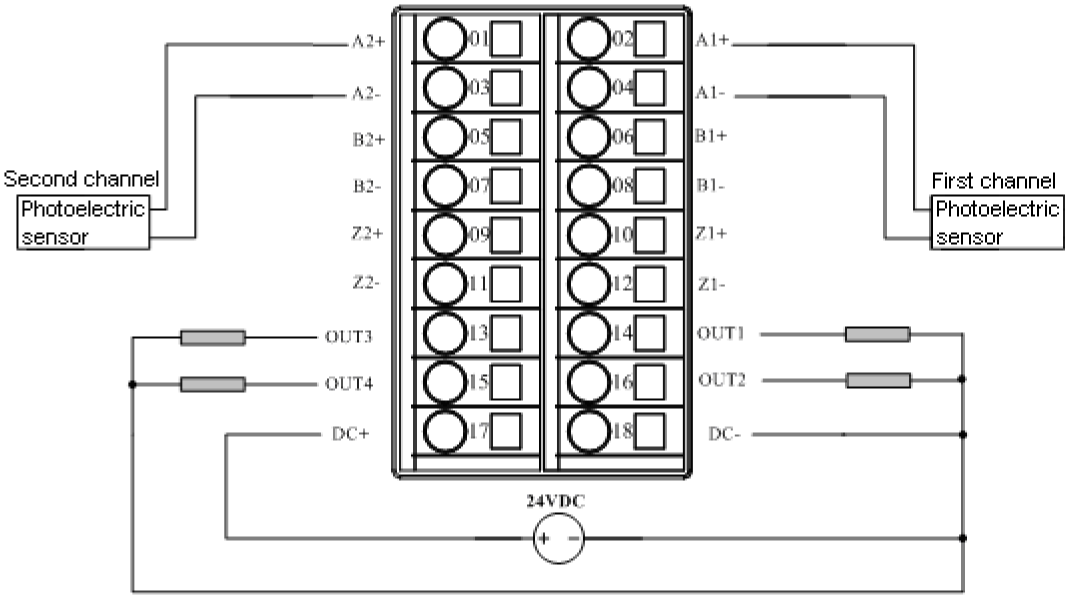


Figure 10.58: Connection of LK680 with photoelectric sensors

As shown in Figure 10.58, the outputs of photoelectric sensor are connected to the A and Z inputs of LK680 module, and B is open.

Connection with proximity sensors

As shown in Figure 10.59, the output of proximity sensor is connected to input A of LK680 module, and B and Z are open.

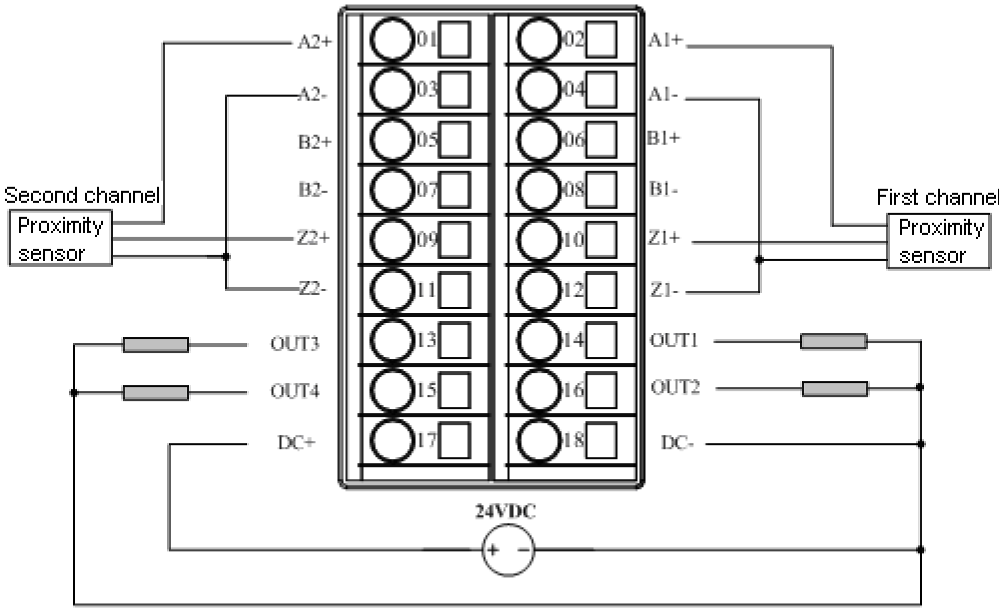


Figure 10.59: Connection of LK680 with proximity sensors

10.3.10 Wiring to Terminal Modules

Please refer to the information found on Chapter 12: Terminal Module.

10.3.11 Specifications of Diagnosis

In PowerPro V4 configuration software, the diagnosis functions are fulfilled by calling the expansion diagnosis library. For high-speed modules, the users can use the high-speed bus diagnosis library (HS_LocalBusSlaveDiag) to diagnose high-speed modules in a certain slot (NodeID) on the local backplane.

The diagnosis library can provide diagnosis information about the operation and status of the module, its channels, field power supply and module parameters. For detailed usage of High-Speed Diagnosis Function Block, please refer to LK Large Scale PLC Instruction Manual.

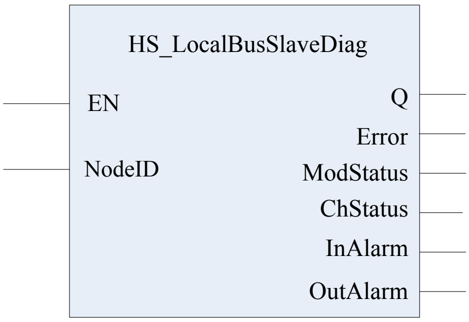
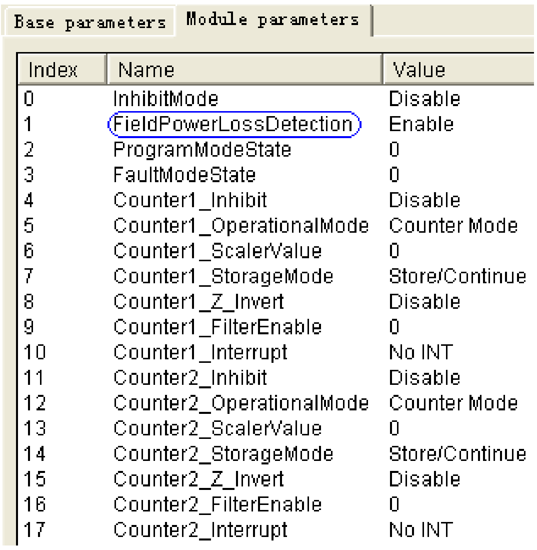


Figure 10.60: High-Speed Bus Diagnosis Function Block of PowerPro V4

Field Power Loss Detection

- LK680 provides function of field-side power supply loss detection. Whether to enable this function can be selected by user parameter “FieldPowerLossDetection”, the default setting of which is “Enable”. Parameter changes can only be effective after a full download.
- Terminal “17” connects to the positive of field power supply while terminal “18” connects to its negative. It carries out power loss detection by checking the changes of input voltage between these two terminals. In case of any failure, the failure status will be reported to the controller as the diagnosis data.
- When the field 24VDC power supply is lost (disconnected or power supply or voltage <5VDC), the device diagnosis data area of LK680 will generate diagnosis byte 0xE8 and report it to the controller in the next scan period.

- ➢ When the field 24VDC power supply is recovered (power supply voltage 10~31.2VDC), the device diagnosis data area of LK680 will generate new diagnosis byte 0xE0 and report it to the controller in the next scan period.
- ➢ LK680 module will only report the diagnosis data once respectively when failure occurs and is recovered.



Base parameters | Module parameters

Index	Name	Value
0	InhibitMode	Disable
1	FieldPowerLossDetection	Enable
2	ProgramModeState	0
3	FaultModeState	0
4	Counter1_Inhibit	Disable
5	Counter1_OperationalMode	Counter Mode
6	Counter1_ScalerValue	0
7	Counter1_StorageMode	Store/Continue
8	Counter1_Z_Invert	Disable
9	Counter1_FilterEnable	0
10	Counter1_Interrupt	No INT
11	Counter2_Inhibit	Disable
12	Counter2_OperationalMode	Counter Mode
13	Counter2_ScalerValue	0
14	Counter2_StorageMode	Store/Continue
15	Counter2_Z_Invert	Disable
16	Counter2_FilterEnable	0
17	Counter2_Interrupt	No INT

Figure 10.61: Enable Selection of LK680 Power Loss Detection

Field power loss diagnosis is device level diagnosis. After calling the high-speed diagnosis function block (HS_LocalBusSlaveDiag), the diagnosis data uploaded by LK680 will be stored in the "ModStatus" output of the function block. That is,

Field power loss, "ModStatus" = 0x28

Field power loss recovery, "ModStatus" = 0x20

10.3.12 Function Specifications

Rollover value

- ➢ Under the counter mode, a rollover value needs to be set for the counter as the upper limit of the count. Valid values are in the range of 1~4,294,967,295.
- ➢ During counting, when the count equals to rollover value minus one, the counter will be reset to 0 and start counting again. If the rollover value is set to 1500, the counting sequence would be: … 1498, 1499, 0, 1, 2, …
- ➢ The rollover value of counter 1 is set using the parameter "Counter1_RolloverValue", and the rollover value of counter 2 is set using the parameter "Counter2_RolloverValue".
- ➢ The roll flag (Counter_Rolled) indicates whether the counter has reached the rollover value and has rolled over. If counter 1 has rolled over, the parameter "Counter1_Rolled" = 0x01. If the counter has not rolled or the flag has been cleared, "Counter1_Rolled" = 0x00.
- ➢ The user may clear the roll flag using the clear roll flag parameter (Counter_ClearRolledFlag), so as to record the next rollover.
- ➢ Under the frequency measuring mode, the rollover value should be set to 0.

```
HS_LK_PLC_Hardware_Configuration
  Local Bus[VAR]
    LK680 HSC 2x1MHz[VAR]
      AT %ID0: DWORD; (* Counter1_PresentValue *) [CHANNEL (I)]
      AT %ID1: DWORD; (* Counter1_StoredValue *) [CHANNEL (I)]
      AT %ID2: DWORD; (* Counter2_PresentValue *) [CHANNEL (I)]
      AT %ID3: DWORD; (* Counter2_StoredValue *) [CHANNEL (I)]
      AT %IB16: BYTE; (* Output1to2_State *) [CHANNEL (I)]
      AT %IB17: BYTE; (* Output3to4_State *) [CHANNEL (I)]
      AT %IB18: BYTE; (* Channel1_Z_State *) [CHANNEL (I)]
      AT %IB19: BYTE; (* Channel2_Z_State *) [CHANNEL (I)]
      AT %IB20: BYTE; (* Counter1_Rolled *) [CHANNEL (I)]
      AT %IB21: BYTE; (* Counter2_Rolled *) [CHANNEL (I)]
      AT %QD0: DWORD; (* Counter1_PresetValue *) [CHANNEL (Q)]
      AT %QD1: DWORD; (* Counter1_RolloverValue *) [CHANNEL (Q)]
      AT %QD2: DWORD; (* Counter1_InterruptValue *) [CHANNEL (Q)]
      AT %QB12: BYTE; (* Counter1_Reset *) [CHANNEL (Q)]
      AT %QB13: BYTE; (* Counter1_LoadPreset *) [CHANNEL (Q)]
      AT %QB14: BYTE; (* Output1_Control *) [CHANNEL (Q)]
      AT %QB15: BYTE; (* Output2_Control *) [CHANNEL (Q)]
      AT %QD4: DWORD; (* Output1_ON_Value *) [CHANNEL (Q)]
      AT %QD5: DWORD; (* Output1_OFF_Value *) [CHANNEL (Q)]
      AT %QD6: DWORD; (* Output2_ON_Value *) [CHANNEL (Q)]
      AT %QD7: DWORD; (* Output2_OFF_Value *) [CHANNEL (Q)]
      AT %QD8: DWORD; (* Counter2_PresetValue *) [CHANNEL (Q)]
      AT %QD9: DWORD; (* Counter2_RolloverValue *) [CHANNEL (Q)]
      AT %QD10: DWORD; (* Counter2_InterruptValue *) [CHANNEL (Q)]
      AT %QB44: BYTE; (* Counter2_Reset *) [CHANNEL (Q)]
      AT %QB45: BYTE; (* Counter2_LoadPreset *) [CHANNEL (Q)]
      AT %QB46: BYTE; (* Output3_Control *) [CHANNEL (Q)]
      AT %QB47: BYTE; (* Output4_Control *) [CHANNEL (Q)]
      AT %QD12: DWORD; (* Output3_ON_Value *) [CHANNEL (Q)]
      AT %QD13: DWORD; (* Output3_OFF_Value *) [CHANNEL (Q)]
      AT %QD14: DWORD; (* Output4_ON_Value *) [CHANNEL (Q)]
      AT %QD15: DWORD; (* Output4_OFF_Value *) [CHANNEL (Q)]
      AT %QB64: BYTE; (* Counter1_ClearRolledFlag *) [CHANNEL (Q)]
      AT %QB65: BYTE; (* Counter2_ClearRolledFlag *) [CHANNEL (Q)]
```

Figure 10.62: LK680 counter rollover value settings

Preset value

- Under counter mode, a preset value can be set for the counter. When the counter is powered on or restarted, the counter will start counting from the preset value. Valid range for preset values is 0~4,294,967,295. Under the frequency measuring mode, the preset value is not used.
- The preset value must be less than the rollover value. If it is greater than the rollover value, the count will be wrong.
- It is worth noting that, when the count reaches the rollover value, the counter will roll over to 0, and start counting from 0, not the preset value, as shown in Figure 10.63.

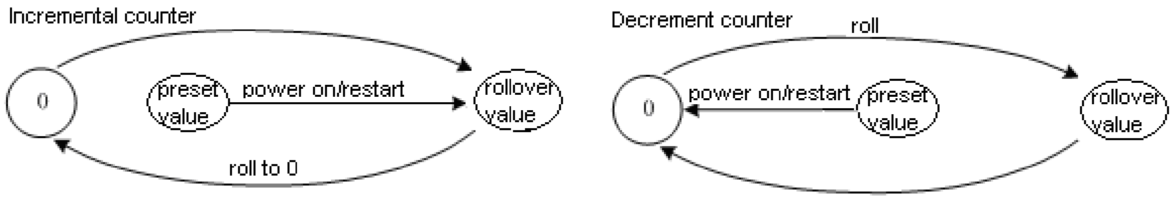


Figure 10.63: Preset value and rollover value of LK680 counters

- The parameter "Counter_Reset" determines if the counter will be reset and start counting. When a rising edge signal (0->1) is written, the counter is reset and starts counting. The parameter "Counter_LoadPreset" determines a preset value will be loaded start counting from the preset value when the counter is reset. When a rising edge signal (0->1) is written, the counter will load the preset value and start counting from the preset value when the counter is reset. If a rising edge signal is written into parameter "Counter_Reset" but not in the parameter "Counter_LoadPreset", the counter will reset and start counting from 0.
- The preset value of counter 1 is set using the parameter "Counter1_PresetValue", and the preset value of counter 2 is set using the parameter "Counter2_PresetValue".

```
HS_LK_PLC_Hardware_Configuration
  Local Bus[VAR]
    LK680 HSC 2x1MHz[VAR]
      AT %ID0: DWORD; (* Counter1_PresentValue *) [CHANNEL (I)]
      AT %ID1: DWORD; (* Counter1_StoredValue *) [CHANNEL (I)]
      AT %ID2: DWORD; (* Counter2_PresentValue *) [CHANNEL (I)]
      AT %ID3: DWORD; (* Counter2_StoredValue *) [CHANNEL (I)]
      AT %IB16: BYTE; (* Output1to2_State *) [CHANNEL (I)]
      AT %IB17: BYTE; (* Output3to4_State *) [CHANNEL (I)]
      AT %IB18: BYTE; (* Channel1_Z_State *) [CHANNEL (I)]
      AT %IB19: BYTE; (* Channel2_Z_State *) [CHANNEL (I)]
      AT %IB20: BYTE; (* Counter1_Rolled *) [CHANNEL (I)]
      AT %IB21: BYTE; (* Counter2_Rolled *) [CHANNEL (I)]
      AT %QD0: DWORD; (* Counter1_PresetValue *) [CHANNEL (Q)]
      AT %QD1: DWORD; (* Counter1_RolloverValue *) [CHANNEL (Q)]
      AT %QD2: DWORD; (* Counter1_InterruptValue *) [CHANNEL (Q)]
      AT %QB12: BYTE; (* Counter1_Reset *) [CHANNEL (Q)]
      AT %QB13: BYTE; (* Counter1_LoadPreset *) [CHANNEL (Q)]
      AT %QB14: BYTE; (* Output1_Control *) [CHANNEL (Q)]
      AT %QB15: BYTE; (* Output2_Control *) [CHANNEL (Q)]
      AT %QD4: DWORD; (* Output1_ON_Value *) [CHANNEL (Q)]
      AT %QD5: DWORD; (* Output1_OFF_Value *) [CHANNEL (Q)]
      AT %QD6: DWORD; (* Output2_ON_Value *) [CHANNEL (Q)]
      AT %QD7: DWORD; (* Output2_OFF_Value *) [CHANNEL (Q)]
      AT %QD8: DWORD; (* Counter2_PresetValue *) [CHANNEL (Q)]
      AT %QD9: DWORD; (* Counter2_RolloverValue *) [CHANNEL (Q)]
      AT %QD10: DWORD; (* Counter2_InterruptValue *) [CHANNEL (Q)]
      AT %QB44: BYTE; (* Counter2_Reset *) [CHANNEL (Q)]
      AT %QB45: BYTE; (* Counter2_LoadPreset *) [CHANNEL (Q)]
      AT %QB46: BYTE; (* Output3_Control *) [CHANNEL (Q)]
```

Figure 10.64: LK680 counter preset value settings

Frequency measuring period

- Under the frequency measuring mode, a time period has to be configured for the frequency measurement, which is called the measuring period. The counter will count the number of pulses received during the specified measuring period.
- The measuring period of the two counters can be set using parameters "Counter1_ScalerValue" and "Counter2_ScalerValue" respectively. The default value is 0, and range of valid values is 0~2000, which represents how many time units (10ms) there are in the measuring period. Example: When counter 1 is in frequency measuring mode, and parameter "Counter1_ScalerValue" = 6, the measuring period of counter 1 will be 6x10ms = 60ms. Suppose counter 1 received 6 pulses during the measuring period, the pulse frequency can be calculated as 6/60ms = 100Hz.
- If the counter is not in the frequency measuring mode, this parameter should be set to 0.
- The maximum allowed value for the parameter is 2000, which means that the longest measuring period will be 2000x10ms = 20s.

Base parameters | Module parameters

Index	Name	Value
0	InhibitMode	Disable
1	FieldPowerLossDetection	Enable
2	ProgramModeState	0
3	FaultModeState	0
4	Counter1_Inhibit	Disable
5	Counter1_OperationalMode	Counter Mode
6	Counter1_ScalerValue	0
7	Counter1_StorageMode	Store/Continue
8	Counter1_Z_Invert	Disable
9	Counter1_FilterEnable	0
10	Counter1_Interrupt	No INT
11	Counter2_Inhibit	Disable
12	Counter2_OperationalMode	Counter Mode
13	Counter2_ScalerValue	0
14	Counter2_StorageMode	Store/Continue
15	Counter2_Z_Invert	Disable
16	Counter2_FilterEnable	0
17	Counter2_Interrupt	No INT

Figure 10.65: LK680 counter measuring period settings

Output ON

- A count value can be set for each output, and when the current count of the counter reaches the value, the output channel outputs ON (that is, the channel is closed). This value is called the output ON value (Output_ON_Value).
- The output ON values for all output points (OUT1/OUT2/OUT3/OUT4) are determined by parameters "Output1_ON_Value", "Output2_ON_Value", "Output3_ON_Value" and "Output4_ON_Value" respectively, which are double word (DWORD) variables with the range 0~4,294,967,295.
- The output ON value should be less than the rollover value. If the output ON value is greater than or equal to the rollover value, the count will not be able to reach the output ON value, and the output channel will not output ON.
- The user parameter "Output Control" can be used to directly control the states of each output point of the counter. For example, if the current output of the output channel 1 (OUT1) is modified to be "ON" by using "Output1Control", the channel will be forced to be closed, regardless whether the current count in counter 1 has reached the output ON value (Ouput1_ON_Value), and the output channel 1 will output and stay at the "ON" state.
- Only when the parameter "Output Control" is set to "Output according to count", the output channel will output ON only when the output ON value is reached.

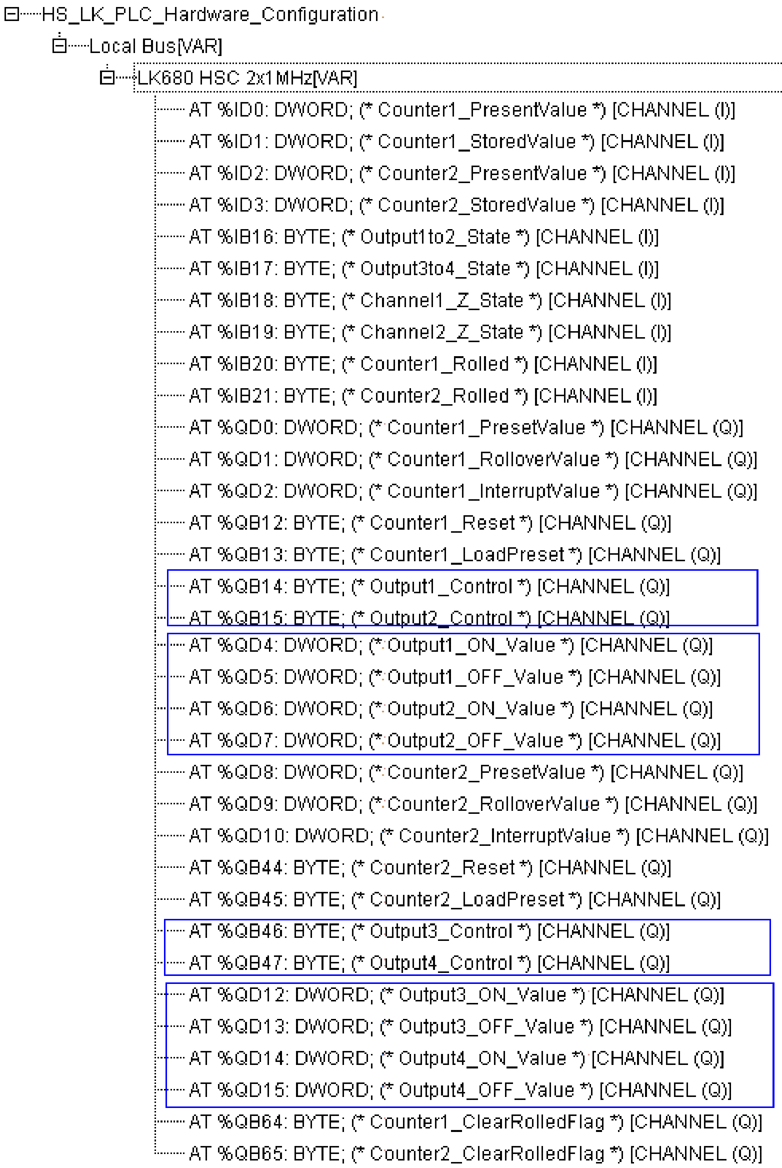


Figure 10.66: LK680 channel output ON/OFF value settings

Output OFF

- Just after power on, output channels remain in the initial state and output OFF. After output is enabled, it will output states configured in the user program. When the module is reset, the output channel will output OFF. After communication is established and parameters re-downloaded, it will output states configured in the user program.
- A count value can be set for each output, and when the current count of the counter reaches the value, the output channel outputs OFF (that is, the channel is open and the output stopped). This value is called the output OFF value (Output_OFF_Value).
- The output OFF value should be less than the rollover value. If the output OFF value is greater than or equal to the rollover value, it will output OFF when the counter rolls over. That is, when the count = (rollover value – 1), the output channel will output OFF, and the counter will roll back to 0 and restart counting.
- The output OFF values for all output points (OUT1/OUT2/OUT3/OUT4) are determined by parameters "Output1_OFF_Value", "Output2_OFF_Value", "Output3_OFF_Value" and "Output4_OFF_Value" respectively, which are double word (DWORD) variables with the range 0~4,294,967,295.
- The user parameter "Output Control" can be used to directly control the states of each output point of the counter. For example, if the current output of the output channel 1 (OUT1) is modified to be "OFF" by using "Output1Control", the channel will be forced to be open, regardless whether the current count in counter 1 has reached the output OFF value (Ouput1_OFF_Value), and the output channel 1 will output and stay at the "OFF" state.
- Only when the parameter "Output Control" is set to "Output according to count", the output channel will output OFF only when the output OFF value is reached.
- When the output OFF value = output ON value, OFF will be output.

- Take the first output point OUT1 of counter 1 for example, if "Output1Control" = 0x00 (output according to count), "Output1_ON_Value" = 3000, "Output1_OFF_Value" = 8000, the output state of the output point OUT1 will be as shown in Figure 10.67. If "Output1Control" = 0x02 (modify output value of OUT1 to OFF) or = 0x03 (modify output value of OUT1 to ON), "Output1_ON_Value" = 3000, "Output1_OFF_Value" – 8000, the output state of the output point OUT1 will be as shown in Figure 10.68.

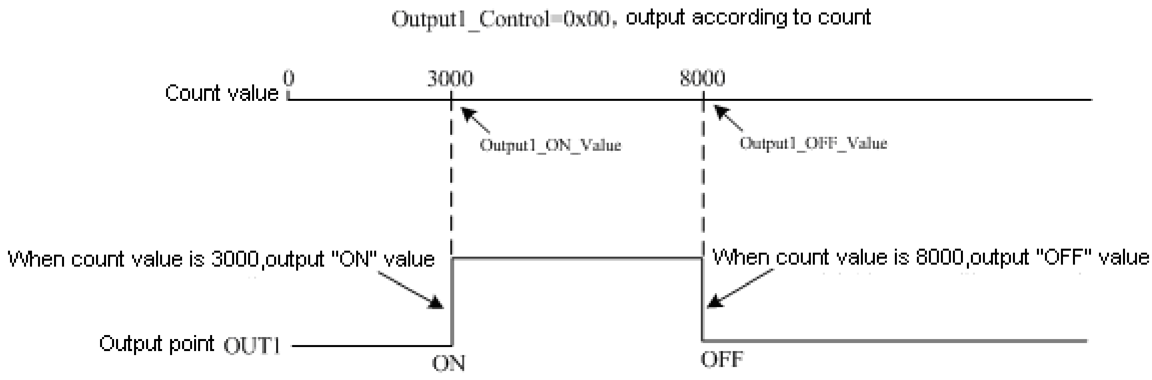


Figure 10.67: Sequence diagram of output OUT1 according to count

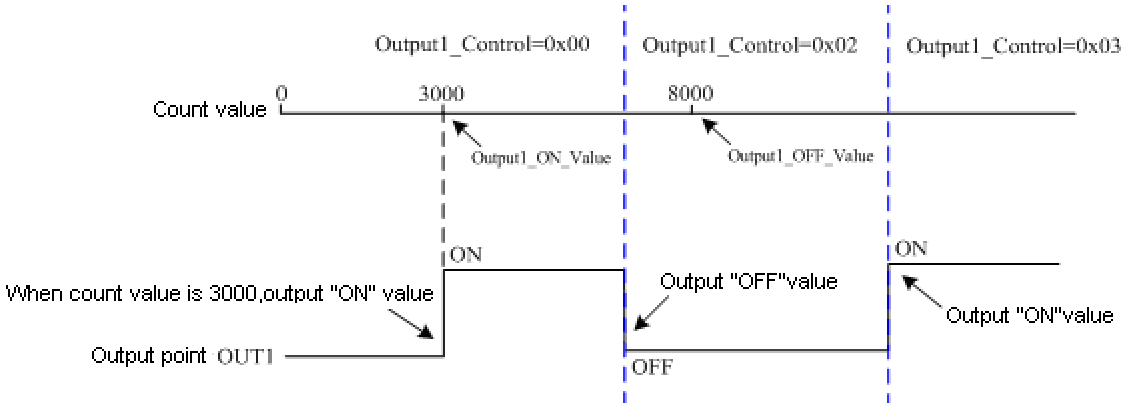


Figure 10.68: Sequence diagram of output OUT1 after output is forcedly modified

Interrupt on match

- An interrupt value (Interrupt Value) can be set for the counter, such that when the current count of the counter equals to the interrupt value, the counter generates an interrupt pulse signal. These types of interrupts are called interrupts on match.
- The interrupt value should be less than the rollover value. The interrupt value of counter 1 is set using the parameter "Counter1_InterruptValue", and the interrupt value of counter 2 is set using the parameter "Counter2_InterruptValue".
- Whether the interrupt on match function is enabled is determined by user parameters.

```
HS_LK_PLC_Hardware_Configuration
  Local Bus[VAR]
    LK680 HSC 2x1MHz[VAR]
      AT %ID0: DWORD; (* Counter1_PresentValue *) [CHANNEL (I)]
      AT %ID1: DWORD; (* Counter1_StoredValue *) [CHANNEL (I)]
      AT %ID2: DWORD; (* Counter2_PresentValue *) [CHANNEL (I)]
      AT %ID3: DWORD; (* Counter2_StoredValue *) [CHANNEL (I)]
      AT %IB16: BYTE; (* Output1to2_State *) [CHANNEL (I)]
      AT %IB17: BYTE; (* Output3to4_State *) [CHANNEL (I)]
      AT %IB18: BYTE; (* Channel1_Z_State *) [CHANNEL (I)]
      AT %IB19: BYTE; (* Channel2_Z_State *) [CHANNEL (I)]
      AT %IB20: BYTE; (* Counter1_Rolled *) [CHANNEL (I)]
      AT %IB21: BYTE; (* Counter2_Rolled *) [CHANNEL (I)]
      AT %QD0: DWORD; (* Counter1_PresetValue *) [CHANNEL (Q)]
      AT %QD1: DWORD; (* Counter1_RolloverValue *) [CHANNEL (Q)]
      AT %QD2: DWORD; (* Counter1_InterruptValue *) [CHANNEL (Q)]
      AT %QB12: BYTE; (* Counter1_Reset *) [CHANNEL (Q)]
      AT %QB13: BYTE; (* Counter1_LoadPreset *) [CHANNEL (Q)]
      AT %QB14: BYTE; (* Output1_Control *) [CHANNEL (Q)]
      AT %QB15: BYTE; (* Output2_Control *) [CHANNEL (Q)]
      AT %QD4: DWORD; (* Output1_ON_Value *) [CHANNEL (Q)]
      AT %QD5: DWORD; (* Output1_OFF_Value *) [CHANNEL (Q)]
      AT %QD6: DWORD; (* Output2_ON_Value *) [CHANNEL (Q)]
      AT %QD7: DWORD; (* Output2_OFF_Value *) [CHANNEL (Q)]
      AT %QD8: DWORD; (* Counter2_PresetValue *) [CHANNEL (Q)]
      AT %QD9: DWORD; (* Counter2_RolloverValue *) [CHANNEL (Q)]
      AT %QD10: DWORD; (* Counter2_InterruptValue *) [CHANNEL (Q)]
      AT %QB44: BYTE; (* Counter2_Reset *) [CHANNEL (Q)]
      AT %QB45: BYTE; (* Counter2_LoadPreset *) [CHANNEL (Q)]
```

Figure 10.69: LK680 interrupt value settings

- As shown in Figure 10.69, after enabling the interrupt on match function, when the interrupt value of counter 1 "Counter1_InterruptValue" = 4000, the interrupt value of counter 2 "Counter2_InterruptValue" = 7000, and the current count = 4000, counter 1 will generate an interrupt pulse; and when the count = 7000, counter 2 will generate an interrupt pulse.

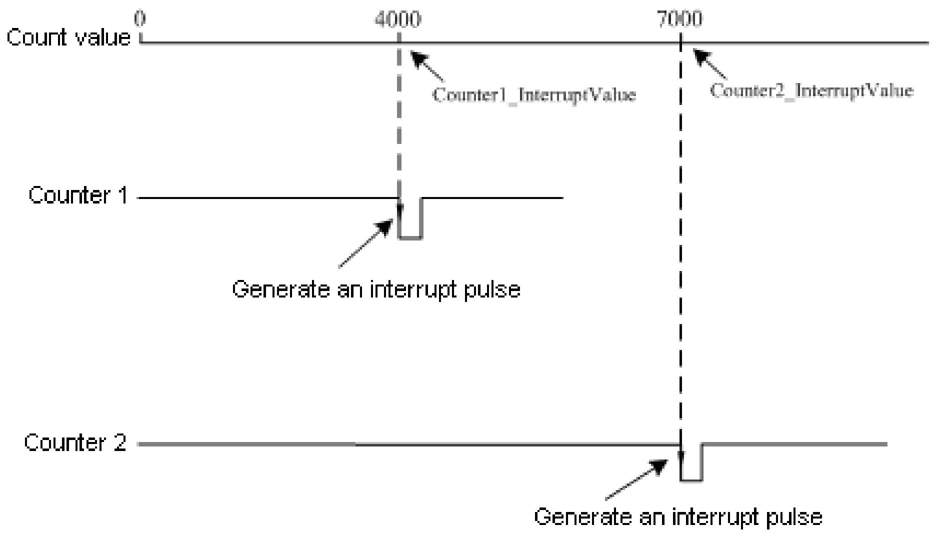


Figure 10.70: Sequence diagram of interrupts on match

- On local backplanes, only the 4 I/O slots closest to the controller support the interrupt function. Hence, LK680 modules with interrupts enabled must be installed in these 4 slots.

Z interrupt (bit 0 interrupt)

- When there is a transition in the input Z signal (by default the rising edge 0→1 is valid, and after "Z inversion" is enabled, the falling edge would be valid), the counter will generate a pulse signal. These types of interrupts are called Z interrupts. The only trigger condition for Z interrupts is the transition of Z signal.

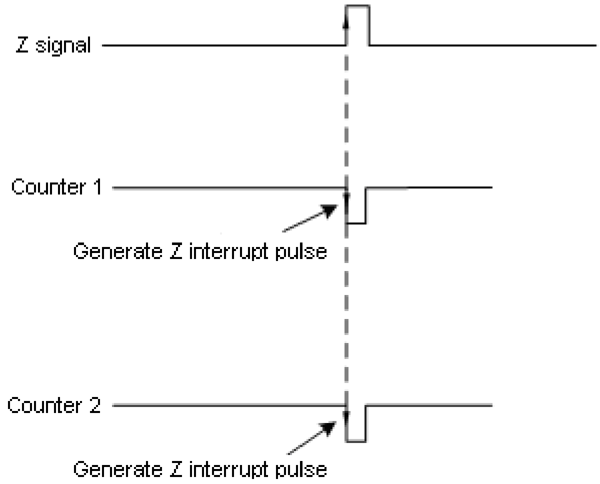


Figure 10.71: Sequence diagram of Z interrupts

- Whether Z interrupts are enabled is determined by user parameters. Interrupt on match and Z interrupt cannot be used at the same time. A counter can only choose one of the interrupt methods.
- Which interrupt to use by counter 1 is determined by the parameter "Counter1_Interrupt", and which interrupt to use by counter 2 is determined by the parameter "Counter2_Interrupt". The default is that interrupts are not enabled (No INT).

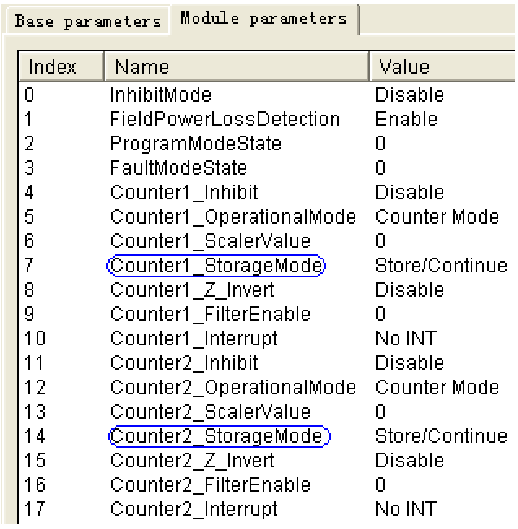
Base parameters | Module parameters

Index	Name	Value
0	InhibitMode	Disable
1	FieldPowerLossDetection	Enable
2	ProgramModeState	0
3	FaultModeState	0
4	Counter1_Inhibit	Disable
5	Counter1_OperationalMode	Counter Mode
6	Counter1_ScalerValue	0
7	Counter1_StorageMode	Store/Continue
8	Counter1_Z_Invert	Disable
9	Counter1_FilterEnable	0
10	Counter1_Interrupt	No INT
11	Counter2_Inhibit	Disable
12	Counter2_OperationalMode	Counter Mode
13	Counter2_ScalerValue	0
14	Counter2_StorageMode	Store/Continue
15	Counter2_Z_Invert	Disable
16	Counter2_FilterEnable	0
17	Counter2_Interrupt	No INT

Figure 10.72: LK680 interrupt enabling

Store count

- When Z signal (by default the rising edge is valid, and after "Z inversion" is enabled, the falling edge would be valid) arrives, the counter can store the current count, until the next Z signal arrives, after which the old count will be overwritten by the new count.
- Whether counter 1 and counter 2 store counts, and which storage mode to use is determined by the parameters "Counter1StorageMode" and "Counter2StorageMode". The default value is "Store/Continue" (store the value and continue counting). In the following we describe the counting of the counter under different storage modes.
- Choosing a storage mode will enable the store count function, and will determine how the counter will store the current count when the Z signal arrives. Choosing "No Store Mode" (do not store counts) will deactivate the store count function.



Base parameters | Module parameters

Index	Name	Value
0	InhibitMode	Disable
1	FieldPowerLossDetection	Enable
2	ProgramModeState	0
3	FaultModeState	0
4	Counter1_Inhibit	Disable
5	Counter1_OperationalMode	Counter Mode
6	Counter1_ScalerValue	0
7	Counter1_StorageMode	Store/Continue
8	Counter1_Z_Invert	Disable
9	Counter1_FilterEnable	0
10	Counter1_Interrupt	No INT
11	Counter2_Inhibit	Disable
12	Counter2_OperationalMode	Counter Mode
13	Counter2_ScalerValue	0
14	Counter2_StorageMode	Store/Continue
15	Counter2_Z_Invert	Disable
16	Counter2_FilterEnable	0
17	Counter2_Interrupt	No INT

Figure 10.73: LK680 storage mode settings

- After the store count function is enabled, LK680 not only report the current count, but will also report the stored count.

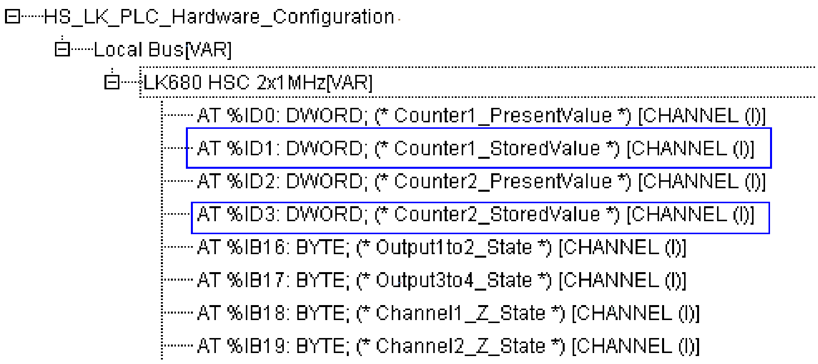


Figure 10.74: LK680 reports the stored count

Storage mode

- When the counter stores count, there are 4 different storage modes:
- Store/Continue (default): The counter stores the current count and continues counting.

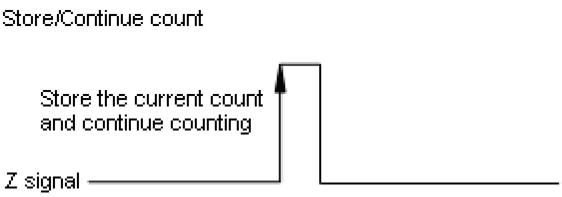


Figure 10.75: LK680 store/continue mode

- Store/Wait/Resume: After the counter stores the current count, the counting stops, and will resume when the falling edge of Z signal arrives.

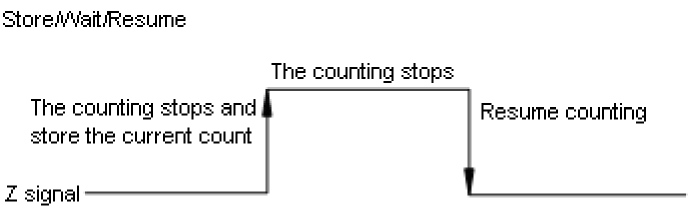


Figure 10.76: LK680 store/wait/resume mode

- Store-Reset/Wait/Start: After the counter stores the current count, the counting stops and the count is cleared. The counting will restart from 0 when the falling edge of Z signal arrives.

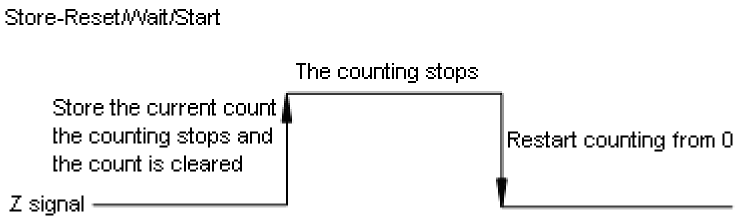


Figure 10.77: LK680 store-reset/wait/start mode

- Store-Reset/Start: The counter stores the current count, reset, and restarts counting from 0.

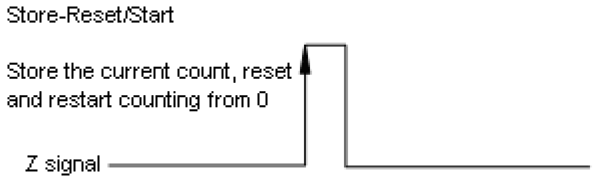


Figure 10.78: LK680 store-reset/start mode

Z signal inversion

- By default, the rising edge of the Z signal is valid. But after enabling the Z signal inversion function, the falling edge of the Z signal will be valid. That is, the falling edge of the Z signal will trigger interrupts, and the counter stores count when the falling edge of Z signal arrives.
- After enabling the Z signal inversion, the trigger conditions for storing counts will be changed to as shown in Figure 10.79.

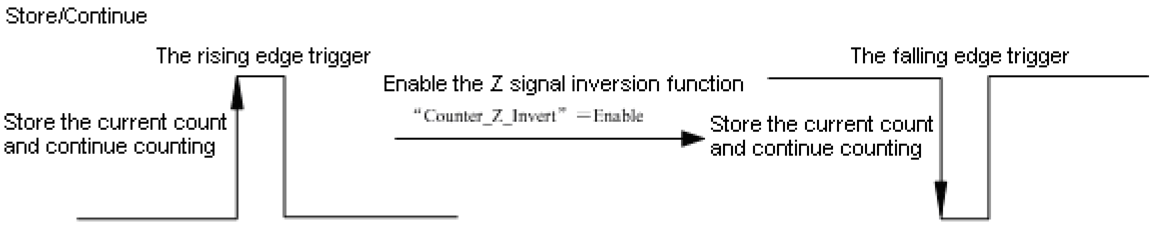


Figure 10.79: LK680 Z signal inversion

- Whether the Z signal of counter 1 is inversed is determined by the parameter "Counter1ZInvertEnable", and whether the Z signal of counter 2 is inversed is determined by the parameter "Counter2ZInvertEnable". The default is not to invert (Disable).

Base parameters | Module parameters

Index	Name	Value
0	InhibitMode	Disable
1	FieldPowerLossDetection	Enable
2	ProgramModeState	0
3	FaultModeState	0
4	Counter1_Inhibit	Disable
5	Counter1_OperationalMode	Counter Mode
6	Counter1_ScalerValue	0
7	Counter1_StorageMode	Store/Continue
8	Counter1_Z_Invert	Disable
9	Counter1_FilterEnable	0
10	Counter1_Interrupt	No INT
11	Counter2_Inhibit	Disable
12	Counter2_OperationalMode	Counter Mode
13	Counter2_ScalerValue	0
14	Counter2_StorageMode	Store/Continue
15	Counter2_Z_Invert	Disable
16	Counter2_FilterEnable	0
17	Counter2_Interrupt	No INT

Figure 10.80: LK680 Z signal inversion enabling

Input filter

- ➢ When the input signal is not a standard pulse signal, input filter can be enabled to filter A, B and Z signals respectively. Whether filters are enabled for the 3 input signals for counter 1 and counter 2 is determined by parameters “Counter1FilterEnable” and “Counter2FilterEnable”. The default is not to enable.
- ➢ The filter sampling interval is 2ms, which requires that the frequency of the input signal is less than 50Hz.

Base parameters | Module parameters

Index	Name	Value
0	InhibitMode	Disable
1	FieldPowerLossDetection	Enable
2	ProgramModeState	0
3	FaultModeState	0
4	Counter1_Inhibit	Disable
5	Counter1_OperationalMode	Counter Mode
6	Counter1_ScalerValue	0
7	Counter1_StorageMode	Store/Continue
8	Counter1_Z_Invert	Disable
9	Counter1_FilterEnable	0
10	Counter1_Interrupt	No INT
11	Counter2_Inhibit	Disable
12	Counter2_OperationalMode	Counter Mode
13	Counter2_ScalerValue	0
14	Counter2_StorageMode	Store/Continue
15	Counter2_Z_Invert	Disable
16	Counter2_FilterEnable	0
17	Counter2_Interrupt	No INT

Figure 10.81: LK680 input filter enabling

Enable Output

- ➢ When user program is operated (the switch key is turned to “RUN” or to “REM” and executes “Run” command in the configuration software), the channel shall output control commands, e.g. the output is enabled. Whether output has been enabled after power on affects the output under fault mode and program mode. Details are as follows.
- ➢ When the module is powered on, the initial position of the key switch on the control panel determines the initial state of the system:
  - o Key switch locates at “RUN” position when the power is on, user program is operated and output is enabled.
  - o Key switch locates at “REM” position when the power is on, user program is not operated, output is not enabled and the module retains initial status with its output channels outputting OFF.
  - o Key switch locates at “PRG” position when the power is on, user program is not operated, output is not enabled and the module retains initial status. At the moment, though module is in program mode, its output is not enabled and its output points (OUT1/ OUT2/ OUT3 /OUT4) all output OFF, not the program mode state. To output program mode state, the key switch shall be turned back to “PRG” position after the user program is operated and the output is enabled.
- ➢ Default position of controller key switch is “REM” that after power on, module retains initial status and output is not enabled. When the user program is operated and the output is enabled, LK680 receives the control commands sent by the controller through high-speed bus and outputs.
- ➢ The output state readback (Output1to2_State、Output3to4_State) sends the output status of each output point to the controller for user programming or channel diagnosis.

```
HS_LK_PLC_Hardware_Configuration
  Local Bus[VAR]
    LK680 HSC 2x1MHz[VAR]
      AT %ID0: DWORD; (* Counter1_PresentValue *) [CHANNEL (I)]
      AT %ID1: DWORD; (* Counter1_StoredValue *) [CHANNEL (I)]
      AT %ID2: DWORD; (* Counter2_PresentValue *) [CHANNEL (I)]
      AT %ID3: DWORD; (* Counter2_StoredValue *) [CHANNEL (I)]
      AT %IB16: BYTE; (* Output1to2_State *) [CHANNEL (I)]
      AT %IB17: BYTE; (* Output3to4_State *) [CHANNEL (I)]
      AT %IB18: BYTE; (* Channel1_Z_State *) [CHANNEL (I)]
      AT %IB19: BYTE; (* Channel2_Z_State *) [CHANNEL (I)]
```

Figure 10.82: LK680 Output State Readback

Communication Failure

In normal communication, LK680 exchanges data with the controller through high-speed bus, each output points of the module (OUT1/ OUT2/ OUT3/ OUT4) outputs data according to the control command sent by the controller.

When communication failure occurs, and the communication with the controller breaks, the "RUN" light flashes. In this case, output channel outputs a state (ON, OFF or counter result) preset in the configuration, know as the Fault Mode State. After the failure recovered, the module receives and executes the output command from the controller again with the "RUN" light constantly on.

LK680 module may be in one of the following states in communication failure:

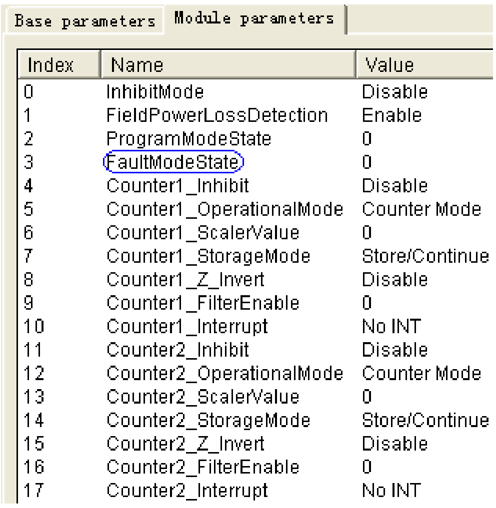
After power on, module cannot establish communication with the controller, then each output points (OUT1/ OUT2/ OUT3/ OUT4) of the module will retain the initial status and the output is not enabled.

Module in operation when communication failure (offline) occurs: each output point outputs fault mode state, counter keeps counting. After parameters are downloaded again, the counter is reset to 0.

Module in program mode when communication failure occurs: each output point outputs fault mode state. When failure is recovered, module returns to program mode.

If the module output has not been enabled, the module does not output fault mode state even if any communication failure occurs.

Fault mode state is configured by user parameter "FaultModeState", and the default is to output OFF (open).



Base parameters | Module parameters

Index	Name	Value
0	InhibitMode	Disable
1	FieldPowerLossDetection	Enable
2	ProgramModeState	0
3	FaultModeState	0
4	Counter1_Inhibit	Disable
5	Counter1_OperationalMode	Counter Mode
6	Counter1_ScalerValue	0
7	Counter1_StorageMode	Store/Continue
8	Counter1_Z_Invert	Disable
9	Counter1_FilterEnable	0
10	Counter1_Interrupt	No INT
11	Counter2_Inhibit	Disable
12	Counter2_OperationalMode	Counter Mode
13	Counter2_ScalerValue	0
14	Counter2_StorageMode	Store/Continue
15	Counter2_Z_Invert	Disable
16	Counter2_FilterEnable	0
17	Counter2_Interrupt	No INT

Figure 10.83: Fault Mode State of LK680 Output Points

Program Mode

- Program mode is a working mode of the controller to modify, edit and download user programs. In program mode, user programs are halted and cannot be restarted through programming software. The output channels keeps counting but do not upload the data; output channels are also not under control when they output a state (ON, OFF or counter result) preset in the configuration, known as the Program Mode State. Modifications on the state can only be effective after the full download.
- Controller can make the slave station enter or exit program mode through the following methods:
- Turn the key switch to "PRG" to force all modules into programming mode. At the moment, controller does not run user program and the output channels of LK680 are not under controller, each output points (OUT1/ OUT2/ OUT3/ OUT4) outputs program mode state.
- After the full-download of user program, module automatically enters program mode no matter whether the key switch on the controller is located at "PRG". If the output channels have never output any data before the download (i.e., output is not enabled), they will retain the initial status and do not output. If the output of output channel has been enabled before the download, the module outputs program mode state.
- Turn the key switch to "RUN", module exits program mode and controller runs the user program.
- Program mode state is configured by user parameter "ProgramModeState", default output is OFF (open).

Base parameters | Module parameters

Index	Name	Value
0	InhibitMode	Disable
1	FieldPowerLossDetection	Enable
2	ProgramModeState	0
3	FaultModeState	0
4	Counter1_Inhibit	Disable
5	Counter1_OperationalMode	Counter Mode
6	Counter1_ScalerValue	0
7	Counter1_StorageMode	Store/Continue
8	Counter1_Z_Invert	Disable
9	Counter1_FilterEnable	0
10	Counter1_Interrupt	No INT
11	Counter2_Inhibit	Disable
12	Counter2_OperationalMode	Counter Mode
13	Counter2_ScalerValue	0
14	Counter2_StorageMode	Store/Continue
15	Counter2_Z_Invert	Disable
16	Counter2_FilterEnable	0
17	Counter2_Interrupt	No INT

Figure 10.84: Program Mode State of LK680 Output Points

Module Inhibition

- Module inhibition function forces slave station module get off the control of user program so that the module will be considered as not existed by the controller. The inhibited LK680 module receives the initialization data sent by the controller, but does not communicate with the controller, report diagnosis information or response to the controller output command. When the module is inhibited, its "RUN" light flashes.
- Whether to inhibit the module is selected by user parameter "Inhibit Mode", the default value of which is "Disable".
- The inhibition function is only effective after a full download. After the full download, all output points enter program mode automatically. If the output points have never output any data before the download (e.g. output is not enabled), they will retain the initial status and do not output. Otherwise, they output program mode state but the counter does not work.
- Inhibition function can also inhibit counter1 or counter 2 separately. When a counter is inhibited, it does not count any more and reports the counter value before the inhibition. Whether to inhibit counter1 is selected by parameter "Counter1_Inhibit" while the inhibition of counter2 is selected by parameter "Counter2_Inhibit", the default setting is "Disable". The inhibition of a single counter only inhibits the counter operation, but not affects the counter's output channel.

Base parameters | Module parameters

Index	Name	Value
0	InhibitMode	Disable
1	FieldPowerLossDetection	Enable
2	ProgramModeState	0
3	FaultModeState	0
4	Counter1_Inhibit	Disable
5	Counter1_OperationalMode	Counter Mode
6	Counter1_ScalerValue	0
7	Counter1_StorageMode	Store/Continue
8	Counter1_Z_Invert	Disable
9	Counter1_FilterEnable	0
10	Counter1_Interrupt	No INT
11	Counter2_Inhibit	Disable
12	Counter2_OperationalMode	Counter Mode
13	Counter2_ScalerValue	0
14	Counter2_StorageMode	Store/Continue
15	Counter2_Z_Invert	Disable
16	Counter2_FilterEnable	0
17	Counter2_Interrupt	No INT

Figure 10.85: Module Inhibition Setting of LK680

10.3.13 Parameter Specifications

After selecting “Local Bus” high-speed backplane link in PowerProV4 configuration software and adding “LK680 HSC2×1MHz" in the Local Bus link, users can configure the LK680 hardware.

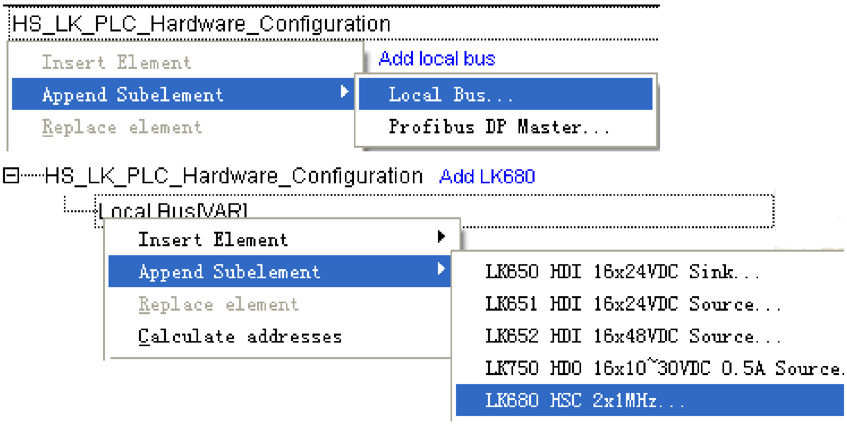


Figure 10.86: Add LK680 in PowerPro V4 Configuration Software

Communication Parameters

- LK680 module communicates and exchanges data with the controller through high-speed local backplane bus with a communication bandwidth of 32Mbps. The high-speed lock bus only needs 2.6μs to input / output a BYTE data.
- Controller read input information from and sent output information to the slave station in cycles. The communication establishment between the controller and LK680 consists of three steps: parameter initialization, configuration and data exchange.
- LK680 high-speed module is installed on the local backplane. The station address is determined only by the installation slot number of LK680. *Refer to Chapter 2: Backplanes for more details.* In the configuration software, the correct station address of the module shall be filled in “Node id” of “Base parameters”. Other parameters shall keep their default values and need no modifications.

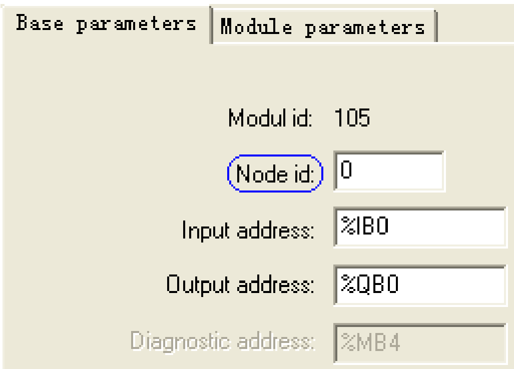


Figure 10.87: Setting of LK680 Communication Address

User Parameters

- The user parameters of LK680 can be divided into two parts: dynamic parameters and static parameters. The dynamic parameters are the data that are updated by the module in every scan period. Existing in the user programs as variable, they shall be assigned a data type and an initial value. The static parameters are used to configure the module’s operating mode. They are written into the controller during the download of user program and will not be read in every scanning circle.
- In the operation of user programs, dynamic parameters can be modified online. But the static parameters do not support online modification; therefore they can only be effective after the full download.
- Updated once in a scan period, dynamic parameters include input data and output data. Input data are those uploaded to the controller by LK680 and output data are those sent to LK680 by the controller, as shown in Table 10.17.
- Each static parameter (Module Parameter) has a default value that can be changed according to requirements of the project. Modifications of parameter values can only be effective after the full download, as shown in Table 10.18.

Parameter Type		Parameter Definition
Output Data	Counter1_PresetValue	Preset value of counter1 (0~4,294,967,295), the value shall be smaller than the rollover value
	Counter1_RolloverValue	Rollover value of counter1 (0~4,294,967,295), in frequency measuring mode, rollover value is 0
	Counter1_InterruptValue	Counter1 interrupt on match value (0~4,294,967,295)
	Counter1_Reset	Counter1 reset and start counting 0x00—>0x01: reset counter1 and start counting from 0. Others: not reset
	Counter1_LoadPreset	Whether counter1 load the preset value and start counting 0x00→0x01: load present value and start counting Others: no action
	Output1_Control	Modification of output1output value =0x00, output according to count result =0x02, modify OUT0 output value to OFF =0x03, modify OUT0 output value to ON
	Output2_Control	Modification of output2 output value =0x00, output according to count result =0x02, modify OUT0 output value to OFF =0x03, modify OUT0 output value to ON
	Output1_ON_Value	Output1 output ON trigger value (0~4,294,967,295)
	Output1_OFF_Value	Output1 output OFF trigger value (0~4,294,967,295)
	Output2_ON_Value	Output2 output ON trigger value (0~4,294,967,295)
	Output2_OFF_Value	Output2 output OFF trigger value (0~4,294,967,295)
	Counter2_PresetValue	Preset value of counter2 (0~4,294,967,295), the value shall be smaller than the rollover value
	Counter2_RolloverValue	Rollover value of counter2 (0~4,294,967,295), in frequency measuring mode, rollover value is 0
	Counter2_InterruptValue	Counter2 interrupt on match value (0~4,294,967,295)
	Counter2_Reset	Counter2 reset and start counting 0x00—>0x01: reset counter2 and start counting from 0. Others: not reset
	Counter2_LoadPreset	Whether counter2 load the preset value and start counting 0x00→0x01: load present value and start counting Others: no action
	Output3_Control	Modification of output3 output value =0x00, output according to count result =0x02, modify OUT0 output value to OFF =0x03, modify OUT0 output value to ON
	Output4_Control	Modification of output4 output value =0x00, output according to count result =0x02, modify OUT0 output value to OFF =0x03, modify OUT0 output value to ON
	Output3_ON_Value	Output3 output ON trigger value (0~4,294,967,295)
	Output3_OFF_Value	Output3 output OFF trigger value (0~4,294,967,295)
	Output4_ON_Value	Output4 output ON trigger value (0~4,294,967,295)
	Output4_OFF_Value	Output4 output OFF trigger value (0~4,294,967,295)
	Counter1_ClearRolledFlag	Counter 1 clear rollover flag 0x00→0x01: clear rollover flag Others: no action
	Counter2_ClearRolledFlag	Counter 2 clear rollover flag 0x00→0x01: clear rollover flag Others: no action
Input Data	Counter1_PresentValue	Present value of counter1 (0~4,291,967,295)

	Counter1_StoredValue	Stored count value of counter1 (0~4,291,967,295)
	Counter2_PresentValue	Present value of counter2 (0~4,291,967,295)
	Counter2_StoredValue	Stored count value of counter2 (0~4,291,967,295)
	Output1to2_State	Bit0 output1 state =0, ON (channel close) =1, OFF (channel open) Bit1 output2 state =0, ON(channel close) =1, OFF (channel open) Bit2~7 reserved
	Output3to4_State	Bit0 output3 state =0, ON(channel close) =1, OFF (channel open) Bit1 output4 state =0, ON(channel close) =1, OFF (channel open) Bit2~7 reserved
	Channel1_Z_State	Channel1 Z state =0x00, low level =0x01, high level
	Channel2_Z_State	Channel2 Z state =0x00, low level =0x01, high level
	Counter1_Rolled	Whether counter1 reach rollover value and rolled =0x00, not rolled =0x01, rolled
	Counter2_Rolled	Whether counter2 reach rollover value and rolled =0x00, not rolled =0x01, rolled

Table 10.17: List of LK680 Dynamic Parameters

```
HS_LK_PLC_Hardware_Configuration
  Local Bus[VAR]
    LK680 HSC 2x1MHz[VAR]
      AT %ID0: DWORD; (* Counter1_PresentValue *) [CHANNEL (I)]
      AT %ID1: DWORD; (* Counter1_StoredValue *) [CHANNEL (I)]
      AT %ID2: DWORD; (* Counter2_PresentValue *) [CHANNEL (I)]
      AT %ID3: DWORD; (* Counter2_StoredValue *) [CHANNEL (I)]
      AT %IB16: BYTE; (* Output1to2_State *) [CHANNEL (I)]
      AT %IB17: BYTE; (* Output3to4_State *) [CHANNEL (I)]
      AT %IB18: BYTE; (* Channel1_Z_State *) [CHANNEL (I)]
      AT %IB19: BYTE; (* Channel2_Z_State *) [CHANNEL (I)]
      AT %IB20: BYTE; (* Counter1_Rolled *) [CHANNEL (I)]
      AT %IB21: BYTE; (* Counter2_Rolled *) [CHANNEL (I)]
      AT %QD0: DWORD; (* Counter1_PresetValue *) [CHANNEL (Q)]
      AT %QD1: DWORD; (* Counter1_RolloverValue *) [CHANNEL (Q)]
      AT %QD2: DWORD; (* Counter1_InterruptValue *) [CHANNEL (Q)]
      AT %QB12: BYTE; (* Counter1_Reset *) [CHANNEL (Q)]
      AT %QB13: BYTE; (* Counter1_LoadPreset *) [CHANNEL (Q)]
      AT %QB14: BYTE; (* Output1_Control *) [CHANNEL (Q)]
      AT %QB15: BYTE; (* Output2_Control *) [CHANNEL (Q)]
      AT %QD4: DWORD; (* Output1_ON_Value *) [CHANNEL (Q)]
      AT %QD5: DWORD; (* Output1_OFF_Value *) [CHANNEL (Q)]
      AT %QD6: DWORD; (* Output2_ON_Value *) [CHANNEL (Q)]
      AT %QD7: DWORD; (* Output2_OFF_Value *) [CHANNEL (Q)]
      AT %QD8: DWORD; (* Counter2_PresetValue *) [CHANNEL (Q)]
      AT %QD9: DWORD; (* Counter2_RolloverValue *) [CHANNEL (Q)]
      AT %QD10: DWORD; (* Counter2_InterruptValue *) [CHANNEL (Q)]
      AT %QB44: BYTE; (* Counter2_Reset *) [CHANNEL (Q)]
      AT %QB45: BYTE; (* Counter2_LoadPreset *) [CHANNEL (Q)]
      AT %QB46: BYTE; (* Output3_Control *) [CHANNEL (Q)]
      AT %QB47: BYTE; (* Output4_Control *) [CHANNEL (Q)]
      AT %QD12: DWORD; (* Output3_ON_Value *) [CHANNEL (Q)]
      AT %QD13: DWORD; (* Output3_OFF_Value *) [CHANNEL (Q)]
      AT %QD14: DWORD; (* Output4_ON_Value *) [CHANNEL (Q)]
      AT %QD15: DWORD; (* Output4_OFF_Value *) [CHANNEL (Q)]
      AT %QB64: BYTE; (* Counter1_ClearRolledFlag *) [CHANNEL (Q)]
      AT %QB65: BYTE; (* Counter2_ClearRolledFlag *) [CHANNEL (Q)]
```

Figure 10.88: LK680 Dynamic Parameter Interface

Module Parameters	Definition	Value
InhibitMode	Whether the module is inhibited =disable, not inhibit the module =Enable, inhibit the module	Disabled (default) Enable
FieldPowerLossDetection	Enable field power loss detection 1= Enable, the function is enabled. =Disable, the function is disabled;	Enable (default) Disable
ProgramModeState	Bit0~1 OUT1 program mode state =0, OFF (default) =01, ON =1x, output according to count result Bit2~3 OUT2 program mode state =0, OFF (default) =01, ON =1x, output according to count result Bit4~5 OUT3 program mode state =0, OFF (default) =01, ON =1x, output according to count result Bit6~7 OUT1 program mode state =0, OFF (default) =01, ON =1x, output according to count result	0 (Default) ~255
FaultModeState	Bit0~1 OUT1 fault mode state =0, OFF (default) =01, ON =1x, output according to count result Bit2~3 OUT2 fault mode state =0, OFF (default) =01, ON =1x, output according to count result Bit4~5 OUT3 fault mode state =0, OFF (default) =01, ON =1x, output according to count result Bit6~7 OUT4 fault mode state =0, OFF (default) =01, ON =1x, output according to count result	0 (Default) ~255
Counter1_Inhibit	Whether to inhibit counter1 =Disable, not inhibit counter1 =Enable, inhibit counter1	Disabled (default) Enable (1)
Counter1_OperationalMode	Counter1 operation mode =counter Mode, counter mode =Encoder x 1 Mode, encoder x 1 Mode =Encoder x 4 Mode, encoder x 4 Mode =Frequency Mode, frequency measuring mode	Counter Mode (default); Encoder×1 Mode; Encoder×4 Mode; Frequency Mode
Counter1_ScalerValue	Frequency measuring time of counter1, value range 0~2000, benchmark unit: 10ms Not in frequency measuring mode, value =0	0 (Default) ~2000
Counter1_StorageMode	Counter1 storage mode =Store/Continue, store / continue count =Store/Wait/Resume, store / wait / resume count =Store-Reset/Wait/Start, store / wait / restart count	Store/Continue (default); Store/Wait/Resume; Store-Reset/Wait/Start;

	=Store-Reset/Start, store / restart count =No Store Mode, not in store mode, count not stored	Store-Reset/Start; No Store Mode
Counter1_Z_Invert	Enable counter 1 Z inversion =Disable, the function is disabled; 1= Enable, the function is enabled.	Disabled (default) Enable
Counter1_FilterEnable	Bit0 enable counter1 A filter (2ms) =0: filter is disabled (default); =1, filter is enabled Bit1 enable counter1 B filter (2ms) =0: filter is disabled (default); =1, filter is enabled Bit2 enable counter1 C filter (2ms) =0: filter is disabled (default); =1, filter is enabled Bit3~bit7 reserved	0 (Default) ~7
Counter1_Interrupt	Setting of counter1 interrupt =No INT, no interrupt = Counter Value INT, enable interrupt on match = Z signal INT, enable Z interrupt	No INT (default); Counter Value INT; Z Signal INT
Counter2_Inhibit	Whether to inhibit counter2 =Disable, not inhibit =Enable, inhibited	Disabled (default) Enable
Counter2_OperationalMode	Counter2 operation mode =counter Mode, counter mode =Encoder x 1 Mode, encoder x 1 Mode =Encoder x 2 Mode, encoder x 4 Mode =Frequency Mode, frequency measuring mode	Counter Mode (default); Encoder×1 Mode; Encoder×4 Mode; Frequency Mode
Counter2_ScalerValue	Frequency measuring time of counter2, value range 0~2000, benchmark unit: 10msNot in frequency measuring mode, value =0	0 (Default) ~2000
Counter2_StorageMode	Counter2 storage mode =Store/Continue, store / continue count =Store/Wait/Resume, store / wait / resume count =Store-Reset/Wait/Start, store / wait / restart count =Store-Reset/Start, store / restart count =No Store Mode, not in store mode, count not stored	Store/Continue (default); Store/Wait/Resume; Store-Reset/Wait/Start; Store-Reset/Start; No Store Mode
Counter2_Z_Invert	Enable counter 2 Z inversion =Disable, the function is disabled; 1= Enable, the function is enabled.	Disabled (default) Enable
Counter2_FilterEnable	Bit0 enable counter2 A filter (2ms) =0: filter is disabled (default); =1, filter is enabled Bit1 enable counter2 B filter (2ms) =0: filter is disabled (default); =1, filter is enabled Bit2 enable counter2 C filter (2ms) =0: filter is disabled (default); =1, filter is enabled Bit3~bit7 reserved	0 (Default) ~7
Counter2_Interrupt	Setting of counter2 interrupt =No INT, no interrupt = Counter Value INT, enable interrupt on match = Z signal INT, enable Z interrupt	No INT (default); Counter Value INT; Z Signal INT

Table 10.18: List of LK680 Configurable Static Parameters (Module Parameters)

Base parameters | Module parameters

Index	Name	Value
0	InhibitMode	Disable
1	FieldPowerLossDetection	Enable
2	ProgramModeState	0
3	FaultModeState	0
4	Counter1_Inhibit	Disable
5	Counter1_OperationalMode	Counter Mode
6	Counter1_ScalerValue	0
7	Counter1_StorageMode	Store/Continue
8	Counter1_Z_Invert	Disable
9	Counter1_FilterEnable	0
10	Counter1_Interrupt	No INT
11	Counter2_Inhibit	Disable
12	Counter2_OperationalMode	Counter Mode
13	Counter2_ScalerValue	0
14	Counter2_StorageMode	Store/Continue
15	Counter2_Z_Invert	Disable
16	Counter2_FilterEnable	0
17	Counter2_Interrupt	No INT

Figure 10.89: LK680 Static Parameter Interface

10.3.14 Module Installation and Un-installation

Refer to chapter 1 on "Module Insertion Mechanical keys" and "Module Insertion and Removable" for more details.

10.3.15 Technical Specification

LK680 24VDC Double Channel High-Speed Counter Module	
System Power Supply	
Power Supply Voltage	24VDC (-10% ~ +10%)
Power Consumption	80mA@24VDC
Counter	
Number of counters	2
Count range	0~4,294,967,295 (32bits)
Count error	±1count code value
Counter input channels	3 channels of isolation voltage pulse signals (A, B, Z) of each counter, total 6 channels of pulse input
Counter Output channels	2 channels of isolated source MOSFET outputs of each counter, total 4 channels of outputs (OUT1~OUT4)
Counter Input (A1, B1, Z1, A2, B2, Z2)	
Pulse rated high level voltage	24V
Pulse high level (ON) voltage range	10~26.4V
Pulse high level input current range	2mA~7mA
Pulse low level (ON) voltage range	0~2V
Pulse low level (OFF) current leak	250μA max.
Input pulse frequency range	0Hz~1MHz (input A, counter mode) 0.1Hz~1MHz (input A, frequency measuring mode) 0Hz~250KHz (input A, B, encoder ×1 or encoder×4) 0Hz~50Hz (input filter enabled)
Isolation voltage between the channel and system	500VAC@1min, Current Leak 5mA
Counter Output (OUT1~OUT4)	
Output type	source
Output Voltage Range	10VDC~31.2VDC
Maximum output current	1.0A@10VDC~31.2VDC
Minimum load current	40mA per output
Maximum On-state Voltage Drop	550mV
Maximum OFF-state Current Leak	300μA per output
Output Delay Time OFF→ON ON→OFF	 20μs (normal), 50μs (maximum) 60μs (normal), 300μs (maximum)
Over-Current Protection	Separate self-recover fuse protection of each channel
Reverse Voltage Protection	None, if there is wrong wiring, output can be damaged
Isolation voltage between the output channel and system	500VAC@1min, Current Leak 5mA
Failure Diagnosis and Hot Swamp	
Field-side Power Loss Detection	Field power loss: device diagnosis byte 0xE8; power recovered: diagnosis byte 0xE0
Hot Swap	Support
Communication Bus	
Protocol	HollySys proprietary protocol
Baud Rate	32Mbps
Media	Communication bus is connected to the backplane through euro connector
Physical Features	
Mechanic Keys to Prevent Incorrect Insertion	F2
Installation	Only supports local backplanes. When set as interrupt mode, can only be installed in the 4 slots closest to the controller.
Dimensions	Width × Height × Depth = 35mm×100mm×100mm
Casing Protection Level	IEC60529 IP20
Weight	185g

Working Environment	
Working temperature	0℃~60℃
Working Relative Humidity	5%~95%, no condensate
Storage Temperature	-40℃~70℃
Storage Relative Humidity	5%~95%, no condensate

Table 10.19: Technical Specification of LK680 Module

Chapter 11

CHAPTER 11: HIGH-SPEED I/O MODULES

11.1 LK650 16-CHANNELS 24VDC HIGH-SPEED SINK DI MODULE

11.1.1 Features

- 16 contacts, sink input
- Input voltage: 10VDC~31.2VDC
- Supports 32Mbps high-speed local bus
- Supports time stamp function
- Supports interrupt function
- Module inhibition function
- Power Loss Detection
- Power supply reverse protection
- System-to-Field Isolation
- Installation only on local backplanes
- Supports hot swap

11.1.2 Operation Principles

LK650 Threshold Level:

- Logical 1: voltage range: 10~31.2VDC, Current range: 2mA (10VDC)~10mA (31.2VDC)
- Logical 0: maximum voltage 5VDc, maximum current 1.5mA

As shown in Figure 11.1, LK650 adopts a sink input with the negative end of the field power supply connecting to the common end of its 16 channels. One end of the switch connects to the positive end of the field power supply while the other end connects to the input end of the module's DI channels. When the switch is closed, the current goes into an optical coupler from the input end, and gets out through the optical coupler to output from the common end and back to the negative end of field power supply.

When the input voltage is in the range of 10~31.2VDC, the Light-emitting diode (LED) side of the optical coupler is connected while the trigger outputs a high voltage level. When the input voltage is smaller or equals to 5VDC or the input current is smaller or equals to 1.5mA, the LED side of the optical coupler is disconnected while the trigger outputs a low voltage level.

The RC filtering circuit filters and debounces the input voltage and the diode provides the function of reverse protection.

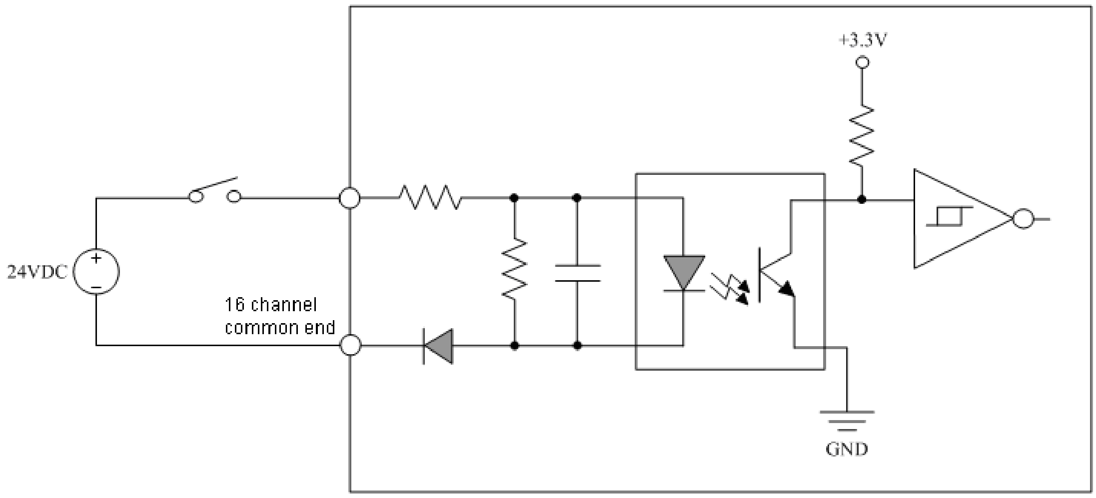


Figure 11.1: LK650 Input Channel Interface Circuit

11.1.3 Indicators Definition

RUN indicator (Green)	On	Communication is established, module in normal operation
	Flash	Communication is not established, communication error or module is disabled
	Off	Power Off or Module Failure
Channel 01~16 Indicator (Yellow)	On	Channel connected
	Off	Channel disconnected

Table 11.1: Definition of LK650 Indicators

Specifications of RUN green light are as follows:

- After the power is on, the module waits for initialization data with the green light flashing with a frequency of 4 times / second.
- After the initialization is completed and the module is in normal operation, the green light is constantly on; if any error occurs in the initialization data, communication is not established and the green light keeps flashing. The setting of communication parameters (slave station address, etc) shall be check to ensure there is no error.
- The green light is constantly on in normal communication; the green light flashes when the communication halts; the green is constantly on again after the communication re-establishes.
- After LK650 is disabled, green light flashes with a frequency of 4 times / second.

11.1.4 Wiring Specifications

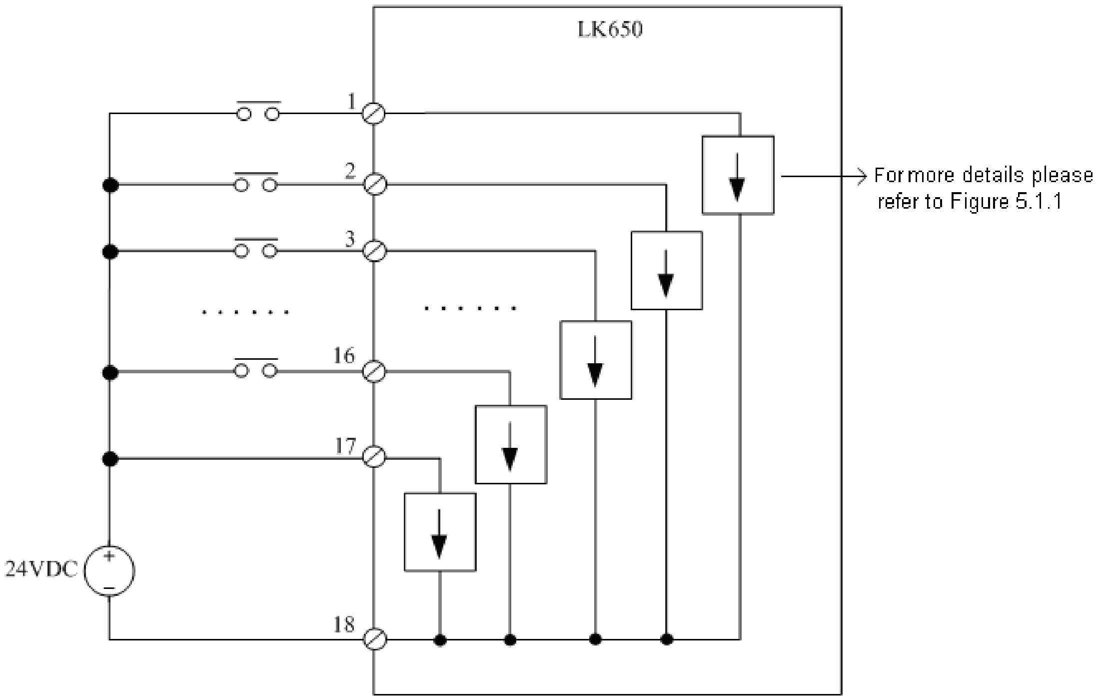


Figure 11.2: LK650 Channel Wiring to Backplane Terminals

LK650 adopts 16 channels of dry contacts; hence it needs a field power supply to drive the optical coupler. To ensure the isolation between field and system, the 24VDC field power supply shall be separated from the backplane power supply.

LK650 is a high-speed module that can be only installed on local backplanes. The local backplanes support two types of wrings: terminal wiring and prefabricated cable wring.

Wiring to Backplane Terminals

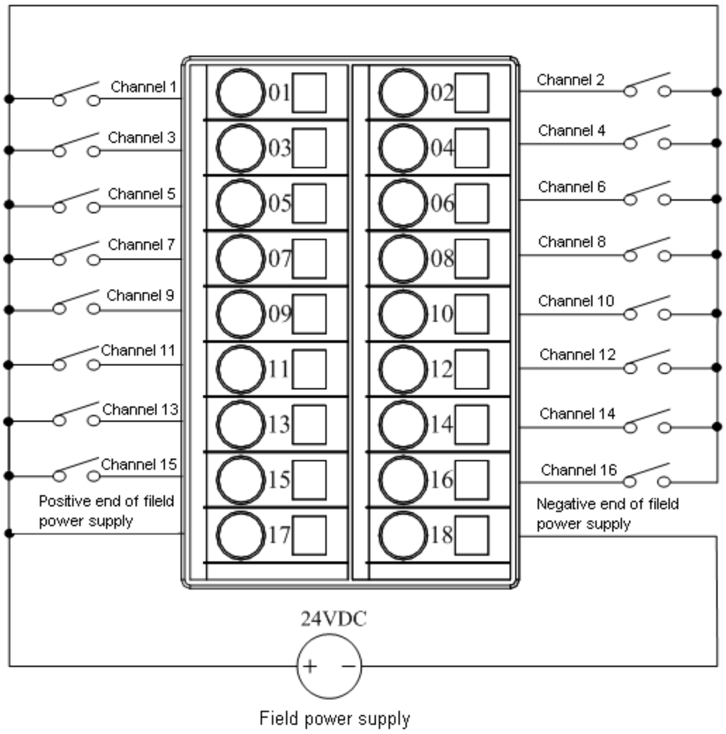


Figure 11.3: LK650 Terminal Wiring through Local Backplane

- LK650 are wired through the correspondence terminals under its local backplane installation slot. The relationship between its channels and the terminals is shown in Figure 11.3. One ends of the 16-channel contacts are connect to their corresponding wiring terminal (01~16) while the other ends are short connect to the positive end of the field power supply.

In the wiring, the following shall be noted:

- External separated 24VDC field power supply.
- Terminal "1~16" are the input ends of the Channel 1~16 contacts.
- Terminal "17" connects to the positive end of the field power supply to enable the field power-loss detection.
- Connecting to the negative end of the field power supply, terminal "18" is the common end of Channel 1~16 inside the module.
- A single terminal shall not be connected to many wires, so multiple-point connection can by established through bus bar or transferring terminal board.

Wiring to Terminal Modules

Please refer to the information found on Chapter 12: Terminal Module.

11.1.5 Diagnosis Specifications

In PowerPro V4 configuration software, the diagnosis functions are fulfilled by calling the expansion diagnosis library. For the high-speed modules, the high-speed bus diagnosis function block HS_LocalBusSlaveDiag in the diagnosis library HS_Diagnosis.lib shall be called to diagnosis the high-speed module on a local backplane slot (NodeID), as shown in Figure 11.4.

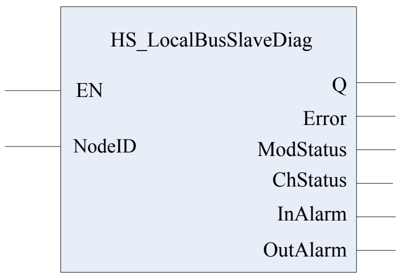


Figure 11.4: High-Speed Bus Diagnosis Function Block of PowerPro V4

The diagnosis library can provide diagnosis information about the operation and status of the module, its channels, field power supply， and module parameters. For detailed usage of High-Speed Diagnosis Function Block, please refer to LK Large Scale PLC Instruction Manual. Users shall note that the Diagnosis library is an external library that shall be first installed in the Library Manager before use.

Field Power Loss Detection

- LK650 provides field power loss detection. The power loss detection function is selectable through user parameter "FieldPowerLossDetection", the default value of which is "Enabled". Parameter changes can only be effective after a full download.
- As shown in Figure 11.5, terminal "17" connects to the positive end of the field power supply while terminal "18" connects to its negative end. LK650 conducts the power loss detection by checking the changes of input voltage between the two terminals. In case of any failure, the failure status will be reported to the controller as the diagnosis data.
- When field power voltage is in the range of 10~31.2VDC, the optical coupler switch of the power loss detection channel is "ON" to indicate that the field power supply work normally; when the field power voltage is smaller than 5VDC, the optical coupler switch of the power loss detection channel is "OFF" to indicate the field power loss; when field power voltage is in the range of 5~10Vdc, the status of the optical coupler switch of the power loss detection channel is not certain.

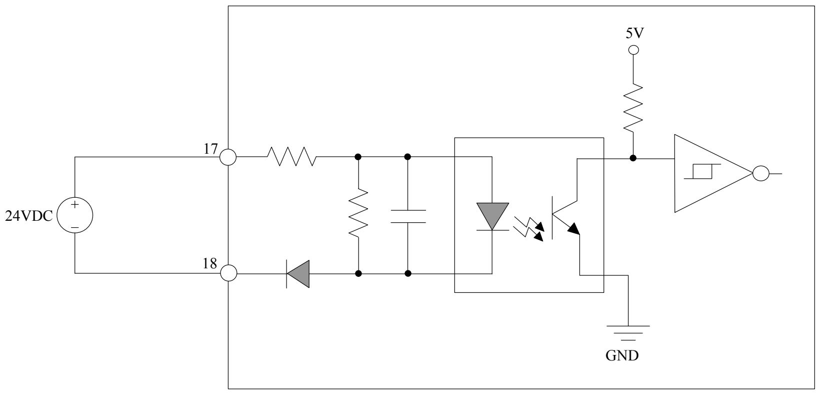
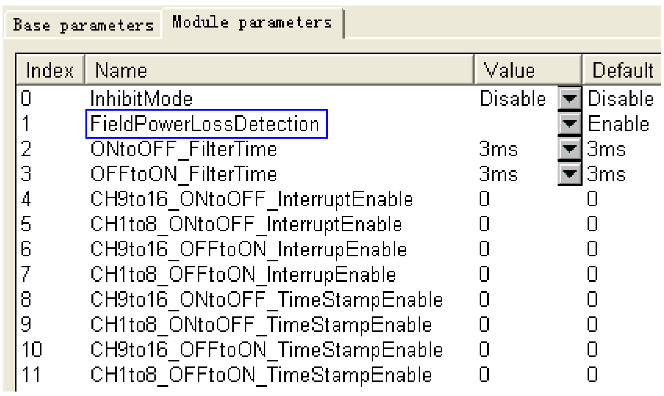


Figure 11.5: LK650 Field Power Loss Detection Circuit

- When the field 24VDC power supply is lost (disconnected or power supply voltage <5VDC), the device diagnosis data area of LK650 will generate diagnosis byte 0x28 and report it to the controller in the next scan period.
- When the field 24VDC power supply is recovered (power supply voltage 10~31.2VDC), the device diagnosis data area of LK650 will generate new diagnosis byte 0x20 and report it to the controller in the next scan period.
- LK650 only reports the diagnosis data once respectively when failure occurs and when the failure is recovered.



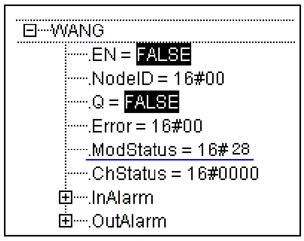
Index	Name	Value	Default
0	InhibitMode	Disable	Disable
1	FieldPowerLossDetection		Enable
2	ONtoOFF_FilterTime	3ms	3ms
3	OFFtoON_FilterTime	3ms	3ms
4	CH9to16_ONtoOFF_InterruptEnable	0	0
5	CH1to8_ONtoOFF_InterruptEnable	0	0
6	CH9to16_OFFtoON_InterrupEnable	0	0
7	CH1to8_OFFtoON_InterrupEnable	0	0
8	CH9to16_ONtoOFF_TimeStampEnable	0	0
9	CH1to8_ONtoOFF_TimeStampEnable	0	0
10	CH9to16_OFFtoON_TimeStampEnable	0	0
11	CH1to8_OFFtoON_TimeStampEnable	0	0

Figure 11.6: Enable Selection of LK650 Power Lost Detection

Field power loss detection is a kind of device diagnosis. The definition of device diagnosis byte is shown in Figure 11.7. After the high-speed diagnosis function block is called, the diagnosis data reported by LK650 will be stored into device output end “ModStatus” of the function block, that is:

Field power loss: ModStatus=0x28

Field power loss recovery: ModStatus=0x20



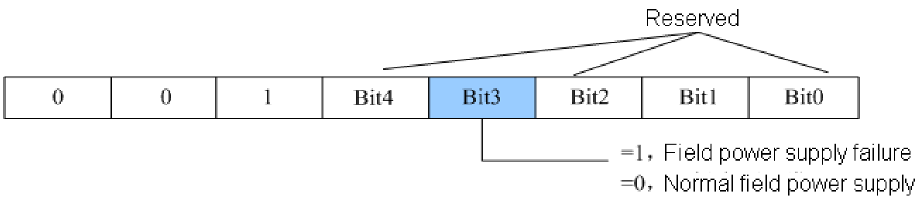


Figure 11.7: Definition of LK650 Device Diagnosis Byte

11.1.6 Function Specifications

Interrupt Function

- Each transition (ON→OFF or OFF→ON) of LK650 channel signals can be set as an event to trigger the operation of the correspondence user program segment in LK controller. This is the Interrupt Function of LK650.
- LK650 selects whether to generate interrupts at the field signal transitions through user parameter (InterruptEnable). The default value of which is not to generate interrupt. The rising and falling edge transition interrupts of each channel are configured separately and differently.

Base parameters | Module parameters

Index	Name	Value	Default
0	InhibitMode	Disable	Disable
1	FieldPowerLossDetection	Enable	Enable
2	ONtoOFF_FilterTime	3ms	3ms
3	OFFtoON_FilterTime	3ms	3ms
4	CH9to16_ONtoOFF_InterruptEnable	0	0
5	CH1to8_ONtoOFF_InterruptEnable	0	0
6	CH9to16_OFFtoON_InterrupEnable	0	0
7	CH1to8_OFFtoON_InterrupEnable	0	0
8	CH9to16_ONtoOFF_TimeStampEnable	0	0
9	CH1to8_ONtoOFF_TimeStampEnable	0	0
10	CH9to16_OFFtoON_TimeStampEnable	0	0
11	CH1to8_OFFtoON_TimeStampEnable	0	0

Figure 11.8: Setting of LK650 Interrupts Function

- On the LK local backplane, only the 4 I/O slots near the controller support the interrupt function. Therefore the LK650 module with its interrupt function configured as enabled shall be installed on these 4 slots.

Time Stamp

- LK650 provides Time Stamp function to record the Coordinated System Time (CST) of the status change in a channel. Coordinated system time is the system time maintained by the controller to synchronize the high-speed I/O modules on the local backplane. CST is recorded by an 8 bytes clock timer in the unit of microsecond (µs). Since the maximum recording range is 264 microseconds (more than 500 thousand years), there is no need to consider timer exceeding when the system is put into operation.
- Adding a time stamp means writing the coordinated system time of the transition moment into the module’s time stamp register. Then the time stamp value and DI signals are uploaded to the controller together through the high speed bus.
- In one scan period, one module can only sent one time stamp to the controller. Therefore, it is suggested to enable the time stamp function in only one channel of one module. If more than one channel in a module enabled the time stamp function at the same time, then only the time stamp value of the last transition in one scan period will be uploaded.
- LK650 sets whether to add time stamp at the moment of field signal transition through user parameter “TimeStampEnable”, the default value of which is “not add time stamp”. Whether to add time stamp at rising edge and falling edge transitions are configured separately and differently in each channel. Only when the time stamp function is enabled in one of its channels, LK650 will record and upload time stamp value.

- Time stamp value consists of 8 BYTE type variables that it can be divided into Timestamp8~Timestamp1 according to the sequence of hexadecimal high byte to low byte.

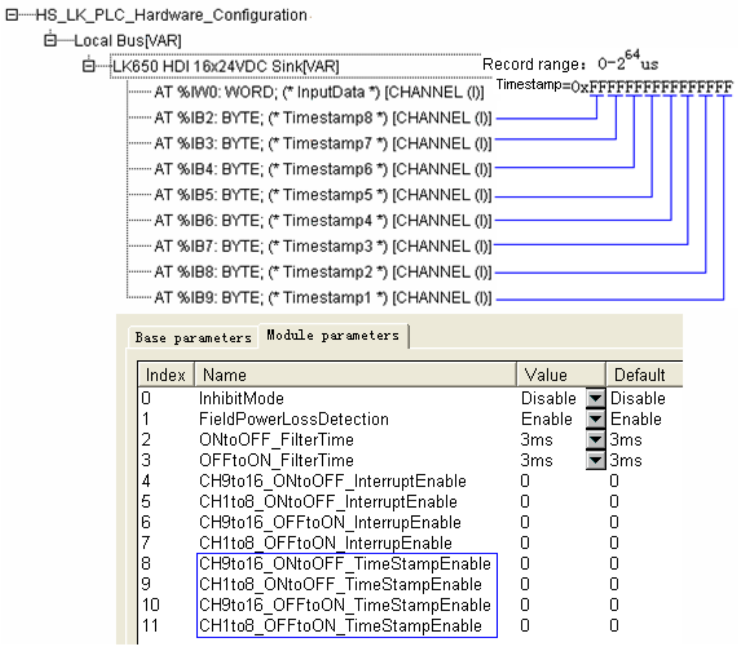


Figure 11.9: Setting of LK650 Time Stamp Function

Module Inhibition

- Module inhibition function forces slave station module get off the control of user program so that the module will be considered as not existed by the controller. The inhibited LK650 module receives the initialization data sent by the controller, but does not communicate with the controller, report diagnosis information nor upload data. The inhibition function is only effective after a full download. The input area is cleared after the full download, so the input value is always 0.
- When the module is inhibited, its “RUN” light flashes.
- Whether to inhibit the module is selected by user parameter “Inhibit Mode”, the default value of which is “Disable”.

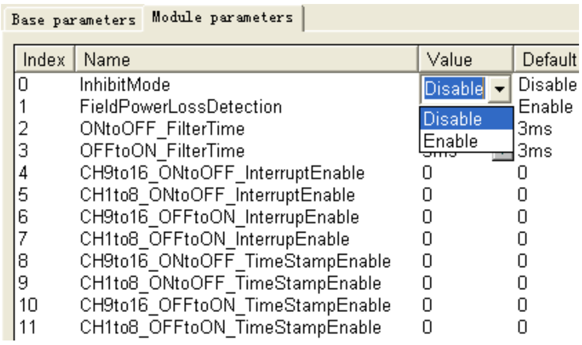


Figure 11.10: Module Inhibition Setting of LK650

Reverse Protection

- LK650 connects a diode in series at the power input negative end for the reverse protection. It protects the internal circuit from any damages when there is wrong connection of the field power positive and negative ends.

11.1.7 Parameter Specifications

Activation of high-speed local bus consists of three steps: parameter initialization, configuration and data exchange. The controller can only read and write the high-speed I/O information regularly after it entered data exchange mode. Therefore, in order to provide correct parameter information in the initialization process, users shall first set the parameters in the configuration software.

Communication Parameters

- Communication address is the node number of high-speed module and controller communication. A unique communication address is assigned to each high-speed module in the bus link. If there is any error of the communication address, the slave station module will not be able to establish communication with the controller.

- LK650 high-speed module is installed on the local backplane. Its unique communication address is determined by the slot number of LK650. Refer to *Chapter 2: Backplanes* for the detailed assignment of communication address.
- When a high-speed module is added in the configuration, it will have a default "Node ID". This ID is not the correct communication address of the high-speed module (determined by the slot number), but only an address assigned automatically by the software according to the adding order.
- As shown in Figure 11.11, the correct communication address shall be re-assigned for each high-speed module in the "NodeID" field of "Basic Parameter". Other parameters shall keep their default values with no modification.
- After adding or deleting high-speed module in configuration or re-locating the slot of high-speed module on the backplane, the communication address in the "NodeID" shall be checked to ensure it is still correct.

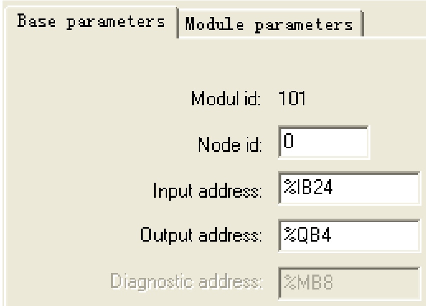


Figure 11.11: Setting of LK650 Communication Address

User Parameters

- There are three ways to process field signals in LK650:
  - Interrupts: When a transition occurs in the field DI signal, an interrupt is generated.
  - Time stamp: When a transition occurs in the field DI signal, a time stamp is added.
  - Module inhibition: Collect field DI signals but do not upload.
- Whether to generate an interrupt add a time stamp or inhibit the module is configured through module parameters. Module parameters are used to configure the module's operating mode. They are written into the controller during the download of user program and will not be read in every scanning circle. Each parameter has a default value that can be changed according to requirements of the project. Module parameters do not support online modifications, therefore they can only be effective after the full download.
- As shown in Table 11.2, module parameters include module inhabitation, software filter time, interrupt enabling, power loss detection enabling and time stamp enabling.

Module Parameters	Parameter Definition
InhibitMode	Whether the module is inhibited =Disable, not inhibited (default) =Enable, inhibited
FieldPowerLossDetection	Field Power Loss Detection =Enable, the function is enabled (default); =Disable, the function is disabled;
ONtoOFF_FilterTime	ON→OFF software filter time =00, 0ms =01, 0.1ms =02, 0.5ms =03, 3ms (Default) =04, 20ms
OFFtoON_FilterTime	OFF→ON software filter time =00, 0ms =01, 0.1ms =02, 0.5ms =03, 3ms (Default) =04, 20ms
IN9to16_ONtoOFF_InterruptEnable	Whether ON→OFF transitions in channels from 9 to 16 generate interrupts Value range: 0 (default) ~255 bit 0 (0 corresponds to channel 9) =0, ON→OFF transitions in channel 9 do not generate interrupts (default) =1, ON→OFF transitions in channel 9 generate interrupts Similarly for bit 1 (channel 10) ~ bit 7 (channel 16)

IN1to8_ONtoOFF_InterruptEnable	Whether ON→OFF transitions in channels from 1 to 8 generate interrupts Value range: 0 (default) ~255 bit 0 (corresponds to channel 1) =0, ON→OFF transitions in channel 1 do not generate interrupts (default) =1, ON→OFF transitions in channel 1 generate interrupts Similarly for bit 1 (channel 2) ~ bit 7 (channel 8)
IN9to16_OFFtoON_InterruptEnable	Whether OFF→ON transitions in channels from 9 to 16 generate interrupts Value range: 0 (default) ~255 bit 0 (corresponds to channel 9) =0, OFF→ON transitions in channel 9 do not generate interrupts (default) =1, OFF→ON transitions in channel 9 generate interrupts Similarly for bit 1 (channel 10) ~ bit 7 (channel 16)
IN1to8_OFFtoON_InterruptEnable	Whether OFF→ON transitions in channels from 1 to 8 generate interrupts Value range: 0 (default) ~255 bit 0 (corresponds to channel 1) =0, OFF→ON transitions in channel 1 do not generate interrupts (default) =1, OFF→ON transitions in channel 1 generate interrupts Similarly for bit 1 (channel 2) ~ bit 7 (channel 8)
IN9to16_ONtoOFF_TimeStampEnable	Whether ON→OFF transitions in channels from 9 to 16 add time stamps Value range: 0 (default) ~255 bit 0 (corresponds to channel 9) =0, channel 9 does not add time stamp (default) =1, channel 9 adds time stamp Similarly for bit 1 (channel 10) ~ bit 7 (channel 16)
IN1to8_ONtoOFF_TimeStampEnable	Whether ON→OFF transitions in channels from 1 to 8 add time stamps Value range: 0 (default) ~255 bit 0 (corresponds to channel 1) =0, channel 1 does not add time stamp (default) =1, channel 1 adds time stamp Similarly for bit 1 (channel 2) ~ bit 7 (channel 8)
IN9to16_OFFtoON_TimeStampEnable	Whether OFF→ON transitions in channels from 9 to 16 add time stamps Value range: 0 (default) ~255 bit 0 (corresponds to channel 9) =0, channel 9 does not add time stamp (default) =1, channel 9 adds time stamp Similarly for bit 1 (channel 10) ~ bit 7 (channel 16)
IN1to8_OFFtoON_TimeStampEnable	Whether OFF→ON transitions in channels from 1 to 8 add time stamps Value range: 0 (default) ~255 bit 0 (corresponds to channel 1) =0, channel 1 does not add time stamp (default) =1, channel 1 adds time stamp Similarly for bit 1 (channel 2) ~ bit 7 (channel 8)

Table 11.2: Definition of LK650 User Parameters

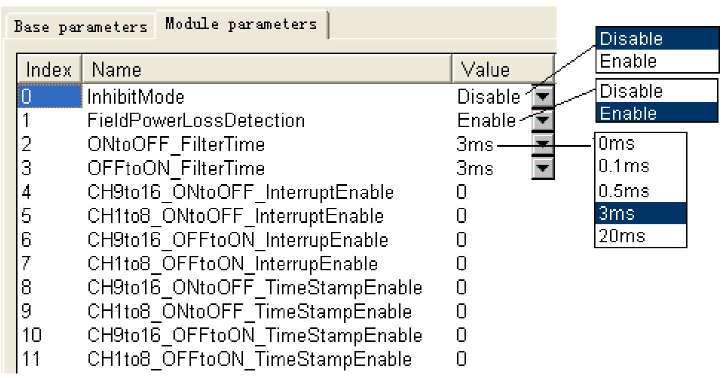


Figure 11.12: LK650 module parameters

Specifications of Data Area

- Input data is the data the will be uploaded from slaves during every scan period. Output data is the data that the controller distributes to slaves during every scan period. When the user program is running, such data can be modified online. The data that LK650 uploads to the controller in every scan period includes channel measurement data and time stamps.

Input Data	Definition
InputData	Channel measurement data (0x0000 ~ 0xFFFF)
TimeStamp8	Time stamp high byte (0x00~0xFF)
TimeStamp7~2	Time stamp middle byte (0x00~0xFF)
TimeStamp1	Time stamp low byte (0x00~0xFF)

Table 11.3: LK650 input and output data definitions

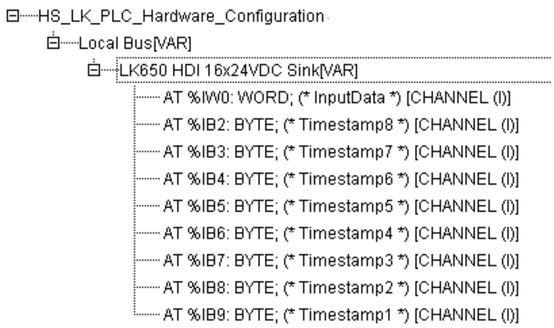


Figure 11.13: LK650 Input/Output Data Interface

11.1.8 Module Installation and Un-installation

Refer to chapter 1 on "Module Insertion Mechanical keys" and "Module Insertion and Removable" for more details.

11.1.9 Technical Specifications

LK650 24VDC 16-Channel Sink High Speed DI Module		
System Power Supply		
System Power Supply Voltage		24VDC (-15% ~ +20%)
System Power Consumption		60mA max@24VDC, exclusive of field power consumption
Input Channel		
Number of Channels		16
Contact Point Type		Dry contact, sink input
Field Power Supply Rated Voltage		24VDC
Channel Closure Rated Voltage		7mA@24VDC
Threshold voltage Level(Vth)	ON	10VDC（2mA）~31.2VDC（10mA）
	OFF	0~5VDC（1.5mA）
Debounce filter time OFF→ON ON→OFF		 0ms, 0.1ms, 0.5ms, 3ms and 20ms configurable. Hardware delay 15μs~30μs 0ms, 0.1ms, 0.5ms, 3ms and 20ms configurable. Hardware delay 30μs~45μs
Reverse Protection		Maximum Voltage 60VDC
Isolation Voltage between Field and System		500VAC@1min, Current Leak 5mA
Failure Diagnosis and Hot Swamp		
Field power loss diagnosis		When power is lost, the reported diagnosis byte is 0x28; when power is restored, 0x20 is reported, and only reported once.
Hot Swap		Support
Communication Bus		
Protocol		HollySys proprietary protocol
Baud Rate		32Mbps
Media		Communication bus is connected to the backplane through euro connector
Physical Features		
Mechanic Keys to Prevent Incorrect Insertion		D0
Installation		Only supports local backplanes. When set as interrupt mode, can only be installed in the 4 I/O slots closest to the controller.
Dimensions		Width × Height × Depth = 35mm×100mm×100mm
Casing Protection Level		IEC60529 IP20
Weight		185g
Working Environment		
Working temperature		0~60°C
Working Relative Humidity		5%~95%, no condensate
Storage Temperature		-40~70°C
Storage Temperature		5%~95%, no condensate

Table 11.4: Technical Index of LK650 Module

11.2 LK651 16-CHANNEL 24VDC HIGH-SPEED SOURCE DI MODULE

11.2.1 Features

- 16 contacts of source input
- Input voltage: 10VDC~31.2VDC
- Installation only on local backplanes
- Supports 32Mbps high-speed local bus
- Supports time stamp function
- Supports interrupt function
- Field Power Loss Detection
- Power supply reverse protection
- System-to-Field Isolation
- Supports hot swap
- Module inhibition function

11.2.2 Operation Principles

Threshold Level of LK651:

- Logic 1: voltage range 10~31.2VDC, Current 2mA (10VDC) ~ 10mA (31.2VDC)
- Logic 0: maximum voltage 5VDC, maximum current 1.5mA

As shown in Figure 11.14, LK651 adopts source input with the common ends of its 16 channels connected to the positive end of field power supply. One end of the switch connects the negative end of field power supply while the other end connects to the input end of DI channel. When the switch is closed, current goes into the optical coupler from the common end, and gets out of the input end to go back to the negative end of field power supply through the switch.

When input voltage is in the range of 10~31.2VDC, the Light Emitting Diode (LED) side of the optical coupler is connected and the trigger outputs a high voltage level; when input voltage is lower than or equals to 5VDC or the input current is smaller than or equals to 1.5mA, the LED side of the optical coupler is disconnected and the trigger outputs a low voltage level.

RC filter circuit filters and debounces the input voltage while the diode provides the reverse protection function.

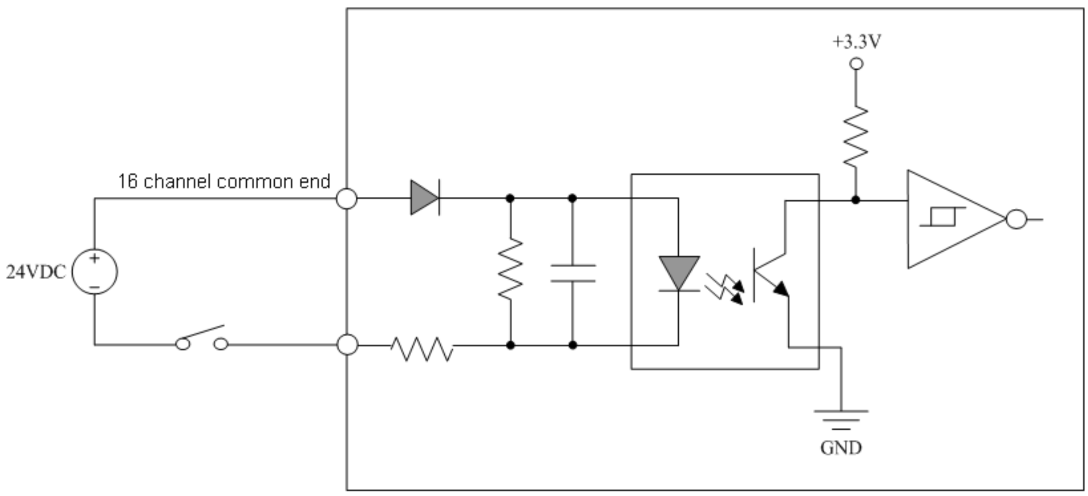


Figure 11.14: LK651 Channel Interface Circuit

11.2.3 Indicators Definition

RUN indicator (Green)	On	Communication is established, module in normal operation
	Flash	Communication is not established, communication error or module is disabled
	Off	Power off of the module
Channel01~16 Indicators (Yellow)	On	The channel is connected
	Off	Channel is disconnected

Table 11.5: Definition of LK651 Indicators

Specifications of RUN green light are as follows:

- After the power is on, the module waits for initialization data while the green light flashes with a frequency of 4 times per second.
- After the initialization is completed, the green light is constantly on to indicate the module in normal operation; if any error occurs in the initialization, then the communication is not established and the green light keeps flashing. Then, communication parameter settings shall be checked.
- Green light is constantly on in normal communications; green light flashes when communication breaks; green light returns to constant on when communication re-established.
- After LK651 is disabled, green light flashes at a frequency of 4 times / second.

11.2.4 Wiring Specifications

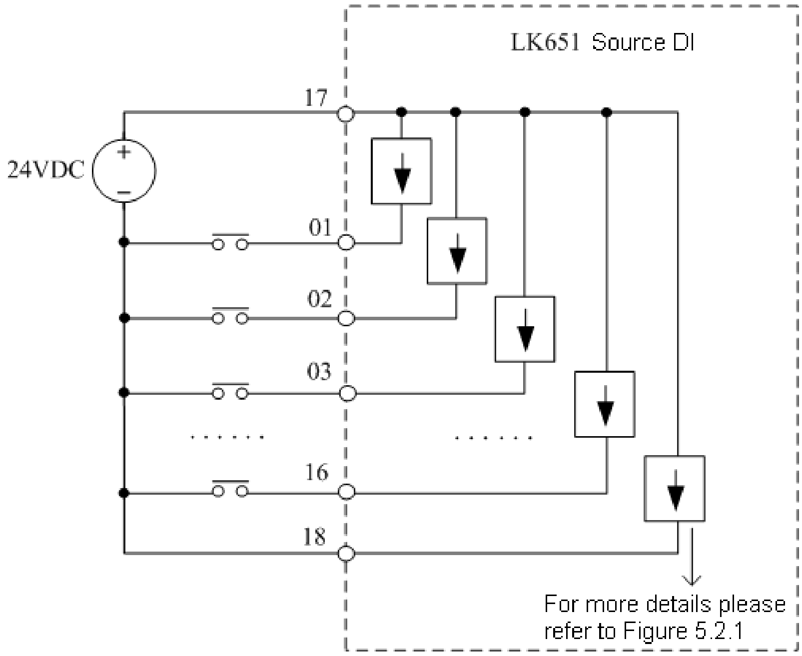


Figure 11.15: LK651 Channel Interface of 16 Digital Inputs

Adopting 16 channels of dry contact points, LK651 needs a field power supply to drive its optical coupler. To ensure the isolation between field and system, this 24VDC field power supply shall be separated from the backplane power supply.

LK651 is a high-speed module that can be only installed on local backplanes. The local backplanes support two types of wrings: terminal wiring and prefabricated cable wring.

Wiring to Backplane Terminals

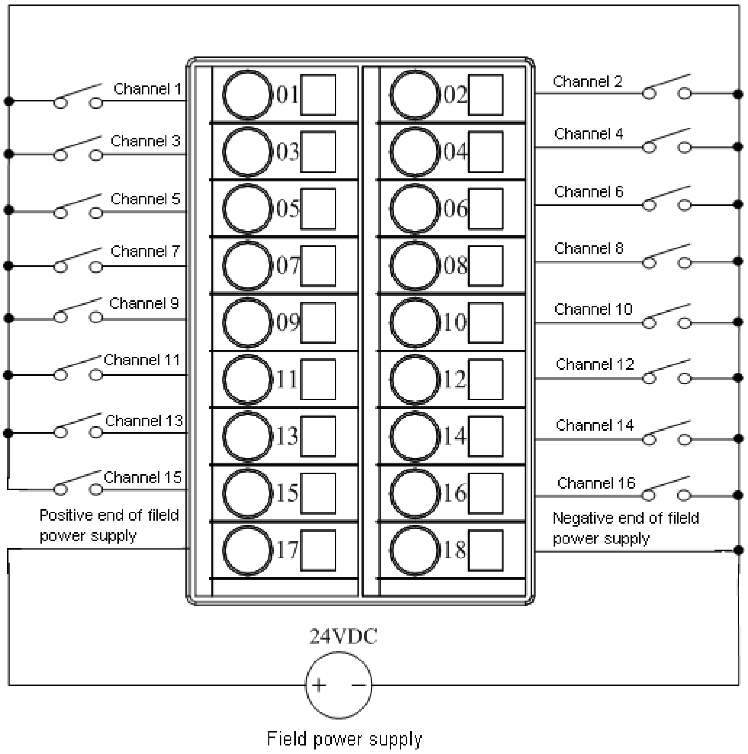


Figure 11.16: Wiring of LK651 Backplane Terminals

LK651 are wired through the correspondence terminals under its local backplane installation slot. The relationship between its channels and the terminals is shown in Figure 11.16. One ends of the 16 channel contacts connect to the wiring terminals (01~16) of the correspondence channels while the other ends connect to the negative end of field power supply.

In the wiring, the following shall be noted:

- To ensure the electric isolation between the field and the system, LK651 need a separated external 24VDC field power supply (e.g., the 24VDC power supply on the backplane cannot be shared as the field power).
- The 24VDC field power supply is shared by all 16 channels.
- Terminal "1~16" are the dry contact digital input ends of Channel 1~16.
- Terminal "17" connects to the positive end of field power supply and is the module's internal common end of Channel 1~16.
- Terminal "18" can connect to the negative end of field power supply for the field power loss detection. It can be disconnected when the module does not need the power loss detection function.
- A single terminal shall not be connected to many wires; therefore multiple-point connection can be established through bus bar or transferring terminal board.

Wiring to Terminal Modules

Please refer to the information found on Chapter 12: Terminal Module.

11.2.5 Diagnosis Specifications

In PowerPro V4 configuration software, the diagnosis functions are fulfilled by calling the expansion diagnosis library. For the high-speed modules, the high-speed bus diagnosis function block HS_LocalBusSlaveDiag in the diagnosis library HS_Diagnosis.lib shall be called to diagnosis the high-speed module on a local backplane slot (NodeID), as shown in Figure 11.17.

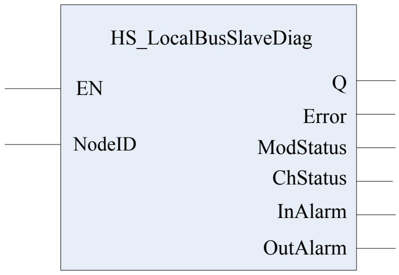


Figure 11.17: High-Speed Bus Diagnosis Function Block of PowerPro V4

The diagnosis library can provide diagnosis information about the operation and status of the module, its channels, field power supply and module parameters. For detailed usage of High-Speed Diagnosis Function Block, please refer to LK Large Scale PLC Instruction Manual. Users shall note that the Diagnosis library is an external library that shall be first installed in the Library Manager before use.

Field Power Loss Detection

- LK651 provides field power loss detection. The power loss detection function is selectable through user parameter "FieldPowerLossDetection", the default value of which is "Enabled". Parameter changes can only be effective after a full download.
- As shown in Figure 11.18, terminal "17" connects to the positive end of field power supply while terminal "18" connects to its negative end.LK651 carries out power loss detection by checking the changes of input voltage between these two terminals. In case of any failure, the failure status will be reported to the controller as the diagnosis data.
- When the field power supply voltage is in the range of 10~31.2VDC, the optical coupler switch of power loss detection channel is "ON" to indicate that field power supply is normal; when the field power supply voltage is between 0~5VDC, the optical coupler switch of power loss detection channel is "OFF" to indicate the field power loss; when the field power supply voltage is in the range of 5~10VDC, the status of the optical coupler switch is not determined.

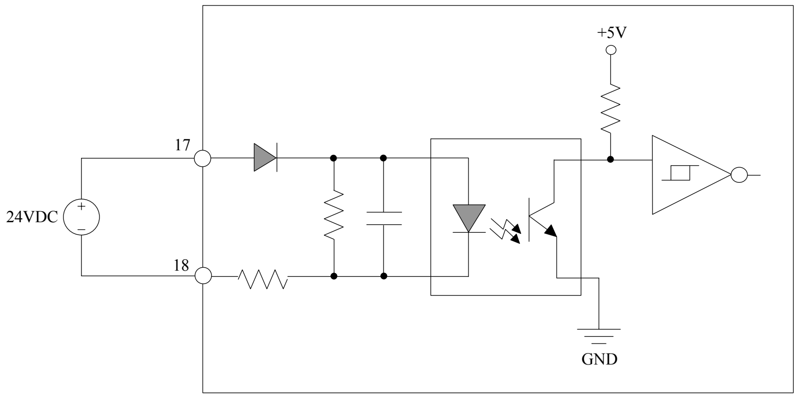


Figure 11.18: Field Power Loss Detection Circuit of LK651

- When the field 24VDC power supply is lost (disconnected or power supply voltage <5VDC), the device diagnosis data area of LK651 will generate diagnosis byte 0x28 and report it to the controller in the next scan period.
- When the field 24VDC power supply is recovered (power supply voltage 10~31.2VDC), the device diagnosis data area of LK651 will generate new diagnosis byte 0x20 and report it to the controller in the next scan period.
- LK651 module will only report the diagnosis data once respectively when failure occurs and is recovered.

Base parameters | Module parameters

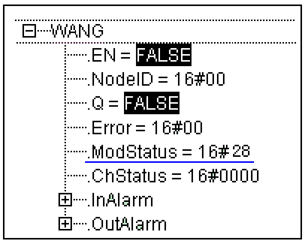
Index	Name	Value	Default
0	InhibitMode	Disable	Disable
1	FieldPowerLossDetection	Enable	Enable
2	ONtoOFF_FilterTime	Disable	3ms
3	OFFtoON_FilterTime	Enable	3ms
4	CH9to16_ONtoOFF_InterruptEnable	0	0
5	CH1to8_ONtoOFF_InterruptEnable	0	0
6	CH9to16_OFFtoON_InterruptEnable	0	0
7	CH1to8_OFFtoON_InterruptEnable	0	0
8	CH9to16_ONtoOFF_TimeStampEnable	0	0
9	CH1to8_ONtoOFF_TimeStampEnable	0	0
10	CH9to16_OFFtoON_TimeStampEnable	0	0
11	CH1to8_OFFtoON_TimeStampEnable	0	0

Figure 11.19: Enable Selection of LK651 Power Lost Detection

➢ Field power loss detection is a kind of device diagnosis. The definition of device diagnosis byte is shown in Figure 11.20. After the high-speed diagnosis function block is called, the diagnosis data reported by LK651 will be stored into device output end "ModStatus" of the function block, that is:

Field power loss: ModStatus=0x28

Field power loss recovery: ModStatus=0x20



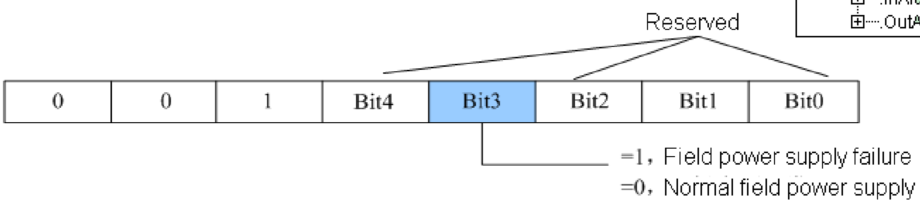


Figure 11.20: Definition of LK651 Device Diagnosis Byte

11.2.6 Function Specifications

Interrupts

➢ Each transition (ON→OFF or OFF→ON) of LK651 channel signals can be set as an event to trigger the operation of the correspondence user program segment in LK controller. This is the interrupt of LK651.

➢ LK651 selects whether to generate interrupts at the field signal transitions through user parameter (InterruptEnable). The default value of which is not to generate interrupt. The rising and falling edge transition interrupts of each channel are configured separately and differently.

Base parameters | Module parameters

Index	Name	Value	Default
0	InhibitMode	Disable	Disable
1	FieldPowerLossDetection	Enable	Enable
2	ONtoOFF_FilterTime	3ms	3ms
3	OFFtoON_FilterTime	3ms	3ms
4	CH9to16_ONtoOFF_InterruptEnable	0	0
5	CH1to8_ONtoOFF_InterruptEnable	0	0
6	CH9to16_OFFtoON_InterruptEnable	0	0
7	CH1to8_OFFtoON_InterrupEnable	0	0
8	CH9to16_ONtoOFF_TimeStampEnable	0	0
9	CH1to8_ONtoOFF_TimeStampEnable	0	0
10	CH9to16_OFFtoON_TimeStampEnable	0	0
11	CH1to8_OFFtoON_TimeStampEnable	0	0

Figure 11.21: Setting of LK651 Interrupts Function

➢ On the LK local backplane, only the 4 I/O slots near the controller support the interrupt function. Therefore the LK651 module with its interrupt function configured as enabled shall be installed on these 4 slots.

Time Stamp

➢ LK651 provides Time Stamp function to record the Coordinated System Time (CST) of the status change in a channel. Coordinated system time is the system time maintained by the controller to synchronize the high-speed I/O modules on the local backplane. CST is recorded by an 8 bytes clock timer in the unit of microsecond (μs). Since the maximum recording range is 264 microseconds (more than 500 thousand years), there is no need to consider timer exceeding when the system is put into operation.

- Adding a time stamp means writing the coordinated system time of the transition moment into the module's time stamp register. Then the time stamp value and DI signals are uploaded to the controller together through the high speed bus.
- In one scan period, one module can only sent one time stamp to the controller. Therefore, it is suggested to enable the time stamp function in only one channel of one module. If more than one channel in a module enabled the time stamp function at the same time, then only the time stamp value of the last transition in one scan period will be uploaded.
- LK651 sets whether to add time stamp at the moment of field signal transition through user parameter "TimeStampEnable", the default value of which is "not add time stamp". Whether to add time stamp at rising edge and falling edge transitions are configured separately and differently in each channel. Only when the time stamp function is enabled in one of its channels, LK651 will record and upload time stamp value.
- Time stamp value consists of 8 BYTE type variables that it can be divided into Timestamp8~Timestamp1 according to the sequence of hexadecimal high byte to low byte.

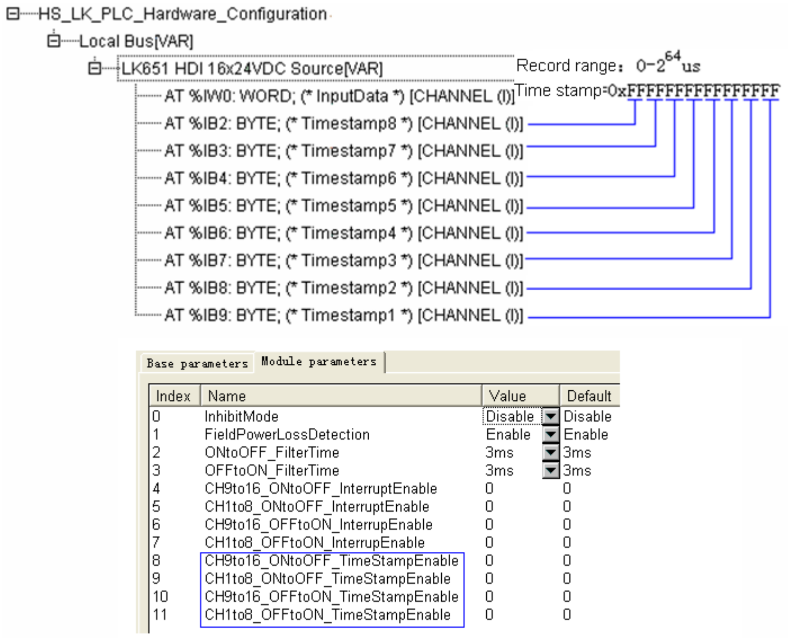


Figure 11.22: Setting of LK651 Time Stamp Function

Module Inhibition

- Module inhibition function forces slave station module get off the control of user program so that the module will be considered as not existed by the controller. The inhibited LK651 module receives the initialization data sent by the controller, but does not communicate with the controller, report diagnosis information nor upload data. The inhibition function is only effective after a full download. The input area is cleared after the full download, so the input value is always 0.
- When the module is inhibited, its "RUN" light flashes.
- Whether to inhibit the module is selected by user parameter "Inhibit Mode", the default value of which is "Disable".

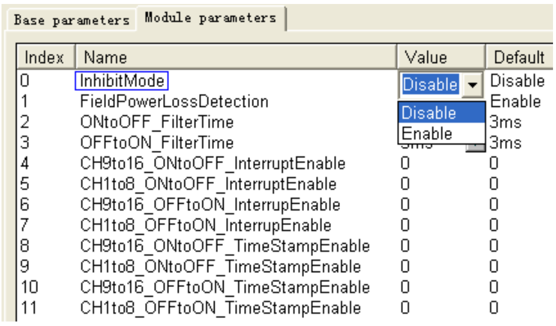


Figure 11.23: Module Inhibition Setting of LK651

Reverse Protection

- LK651 connects a diode in series at the power input positive end for the reverse protection. It protects the internal circuit from any damages when there is wrong connection of the field power positive and negative ends.

11.2.7 Parameter Specifications

Activation of high-speed local bus consists of three steps: parameter initialization, configuration and data exchange. The controller can only read and write the high-speed I/O information regularly after it entered data exchange mode. Therefore, in order to provide correct parameter information in the initialization process, users shall first set the parameters in the configuration software.

Communication Parameters

- Communication address is the node number of high-speed module and controller communication. A unique communication address is assigned to each high-speed module in the bus link. If there is any error of the communication address, the slave station module will not be able to establish communication with the controller.
- LK651 high-speed module is installed on the local backplane. Its unique communication address is determined by the slot number of LK651. *Refer to Chapter 2: Backplanes for the detailed assignment of communication address.*
- When a high-speed module is added in the configuration, it will have a default "Node ID". This ID is not the correct communication address of the high-speed module (determined by the slot number), but only an address assigned automatically by the software according to the adding order.
- As shown in Figure 11.24, the correct communication address shall be re-assigned for each high-speed module in the "NodeID" field of "Basic Parameter". Other parameters keep their default value and do not need modification.
- After adding or deleting high-speed module in configuration or re-locating the slot of high-speed module on the backplane, the communication address in the "NodeID" shall be checked to ensure it is still correct.

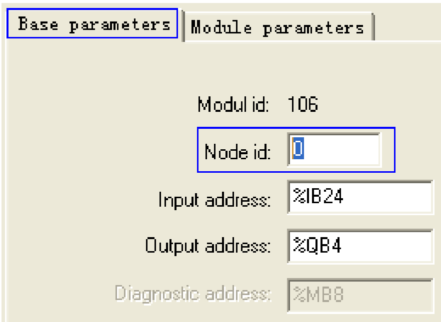


Figure 11.24: Setting of LK651 Communication Address

User Parameters

- There are three ways to process field signals in LK651:
  - Interrupts: When a transition occurs in the field DI signal, an interrupt is generated.
  - Time stamp: When a transition occurs in the field DI signal, a time stamp is added.
  - Module inhibition: Collect field DI signals but do not upload.
- Whether to generate an interrupt, add a time stamp or inhibit the module is configured through module parameters. Module parameters are used to configure the module's operating mode. They are written into the controller during the download of user program and will not be read in every scanning circle. Each parameter has a default value that can be changed according to requirements of the project. Module parameters do not support online modifications; therefore they can only be effective after the full download.
- As shown in Table 11.6, module parameters include module inhabitation, software filter time, interrupt enabling, power loss detection enabling and time stamp enabling.

Parameter Name	Parameter Definition
InhibitMode	Whether the module is inhibited =Disable, not inhibited (default) =Enable, inhibited
FieldPowerLossDetection	Field Power Loss Detection =Enable, the function is enabled (default); =Disable, the function is disabled;
ONtoOFF_FilterTime	ON→OFF software filter time =00, 0ms =01, 0.1ms =02, 0.5ms =03, 3ms (Default) =04, 20ms
OFFtoON_FilterTime	OFF→ON software filter time

	=00, 0ms =01, 0.1ms =02, 0.5ms =03, 3ms (Default) =04, 20ms
IN9to16_ONtoOFF_InterruptEnable	Whether ON→OFF transitions in channels from 9 to 16 generate interrupts Value range: 0 (default) ~255 bit 0 (0 corresponds to channel 9) =0, ON→OFF transitions in channel 9 do not generate interrupts (default) =1, ON→OFF transitions in channel 9 generate interrupts Similarly for bit 1 (channel 10) ~ bit 7 (channel 16)
IN1to8_ONtoOFF_InterruptEnable	Whether ON→OFF transitions in channels from 1 to 8 generate interrupts Value range: 0 (default) ~255 bit 0 (corresponds to channel 1) =0, ON→OFF transitions in channel 1 do not generate interrupts (default) =1, ON→OFF transitions in channel 1 generate interrupts Similarly for bit 1 (channel 2) ~ bit 7 (channel 8)
IN9to16_OFFtoON_InterruptEnable	Whether OFF→ON transitions in channels from 9 to 16 generate interrupts Value range: 0 (default) ~255 bit 0 (corresponds to channel 9) =0, OFF→ON transitions in channel 9 do not generate interrupts (default) =1, OFF→ON transitions in channel 9 generate interrupts Similarly for bit 1 (channel 10) ~ bit 7 (channel 16)
IN1to8_OFFtoON_InterruptEnable	Whether OFF→ON transitions in channels from 1 to 8 generate interrupts Value range: 0 (default) ~255 bit 0 (corresponds to channel 1) =0, OFF→ON transitions in channel 1 do not generate interrupts (default) =1, OFF→ON transitions in channel 1 generate interrupts Similarly for bit 1 (channel 2) ~ bit 7 (channel 8)
IN9to16_ONtoOFF_TimeStampEnable	Whether ON→OFF transitions in channels from 9 to 16 add time stamps Value range: 0 (default) ~255 bit 0 (corresponds to channel 9) =0, channel 9 does not add time stamp (default) =1, channel 9 adds time stamp Similarly for bit 1 (channel 10) ~ bit 7 (channel 16)
IN1to8_ONtoOFF_TimeStampEnable	Whether ON→OFF transitions in channels from 1 to 8 add time stamps Value range: 0 (default) ~255 bit 0 (corresponds to channel 1) =0, channel 1 does not add time stamp (default) =1, channel 1 adds time stamp Similarly for bit 1 (channel 2) ~ bit 7 (channel 8)
IN9to16_OFFtoON_TimeStampEnable	Whether OFF→ON transitions in channels from 9 to 16 add time stamps Value range: 0 (default) ~255 bit 0 (corresponds to channel 9) =0, channel 9 does not add time stamp (default) =1, channel 9 adds time stamp Similarly for bit 1 (channel 10) ~ bit 7 (channel 16)
IN1to8_OFFtoON_TimeStampEnable	Whether OFF→ON transitions in channels from 1 to 8 add time stamps Value range: 0 (default) ~255 bit 0 (corresponds to channel 1) =0, channel 1 does not add time stamp (default) =1, channel 1 adds time stamp Similarly for bit 1 (channel 2) ~ bit 7 (channel 8)

Table 11.6: Definition of LK651 User Parameters

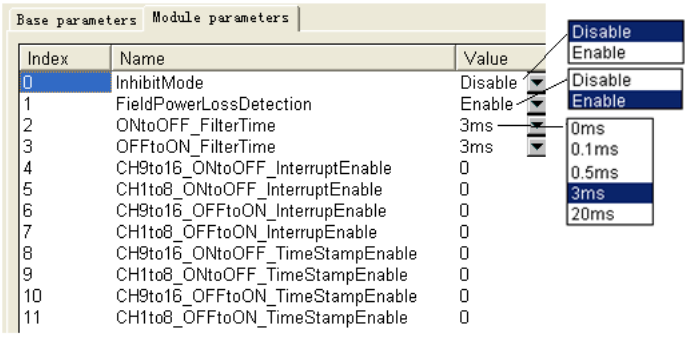


Figure 11.25: LK650 module parameters

Specifications of Data Area

- Input data is the data the will be uploaded from slaves during every scan period. Output data is the data that the controller distributes to slaves during every scan period. When the user program is running, such data can be modified online. The data that LK651 uploads to the controller in every scan period includes channel measurement data and time stamps.

Input Data	Definition
InputData	Channel measurement data (0x0000 ~ 0xFFFF)
TimeStamp8	Time stamp high byte (0x00~0xFF)
TimeStamp7~2	Time stamp middle byte (0x00~0xFF)
TimeStamp1	Time stamp low byte (0x00~0xFF)

Table 11.7: LK651 input and output data definitions

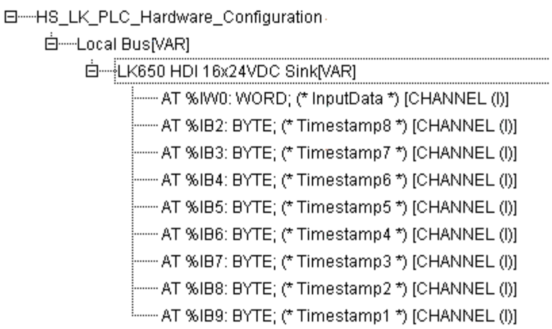


Figure 11.26: LK651 Input/Output Data Interface

11.2.8 Module Installation and Un-installation

Refer to chapter 1 on "Module Insertion Mechanical keys" and "Module Insertion and Removable" for more details.

11.2.9 Technical Specification

LK651 24VDC 16-Channel Source High Speed DI Module		
System Power Supply		
System Power Supply Voltage		24VDC (-15% ~ 20%)
System Power Consumption		60mA max@24VDC, exclusive of field power consumption
Input Channel		
Number of Channels		16
Contact Point Type		Dry contact, source input
Field Power Supply Rated Voltage		24VDC
Channel Closure Rated Voltage		7mA@24VDC
Threshold voltage Level(Vth)	ON	10VDC（2mA）~31.2VDC（10mA）
	OFF	0~5VDC（1.5mA）
Debounce filter time OFF→ON ON→OFF		 Programmable filter: 0ms/0.1ms/0.5ms/3ms/20ms, hardware delay: 15µs~30µs Programmable filter: 0ms/0.1ms/0.5ms/3ms/20ms, hardware delay: 30µs~45µs
Reverse Protection		Maximum Voltage 60VDC
Isolation Voltage between Field and System		500VAC@1min, Current Leak 5mA
Failure Diagnosis and Hot Swamp		
Field power loss diagnosis		When field power is lost, the reported diagnosis byte is 0x28; when power is restored, 0x20 is reported, and only reported once.
Hot Swap		Support
Communication Bus		
Protocol		HollySys proprietary protocol
Baud Rate		32Mbps
Media		Communication bus is connected to the backplane through euro connector
Physical Features		
Mechanic Keys to Prevent Incorrect Insertion		D0
Installation		Only supports local backplanes. When set as interrupt mode, can only be installed in the 4 I/O slots closest to the controller.
Dimensions		Width × Height × Depth = 35mm×100mm×100mm
Casing Protection Level		IEC60529 IP20
Weight		185g
Working Environment		
Working temperature		0~60°C
Working Relative Humidity		5%~95%, no condensate
Storage Temperature		-40~70°C
Storage Temperature		5%~95%, no condensate

Table 11.8: Technical Index of LK651 Module

11.3 LK652 16-CHANNEL 24VDC HIGH-SPEED SOURCE DI MODULE

11.3.1 Features

- 16 contacts of source input
- Input voltage: 30VDC~60VDC
- Supports 32Mbps high-speed local bus
- Supports time stamp function
- Supports interrupt function
- Module inhibition function
- Field Power Loss Detection
- Power supply reverse protection
- System-to-Field Isolation
- Supports hot swap
- Installation only on local backplanes

11.3.2 Operation Principles

Threshold Level of LK652:

- Logic 1: voltage range 30~60VDC, Current 2mA (30VDC) ~ 7mA (60VDC)
- Logic 0: maximum voltage 10VDC, maximum current 1.5mA

As shown in Figure 11.27, LK652 adopts source input with the common ends of its 16 channels connected to the positive end of field power supply. One end of the switch connects the negative end of field power supply while the other end connects to the input end of DI channel. When the switch is closed, current goes into the optical coupler from the common end, and gets out of the input end to go back to the negative end of field power supply through the switch.

When input voltage is in the range of 30~60VDC, the Light Emitting Diode (LED) side of the optical coupler is connected and the trigger outputs a high voltage level; when input voltage is lower than or equals to 5VDC or the input current is smaller than or equals to1.5mA, the LED side of the optical coupler is disconnected and the trigger outputs a low voltage level.

RC filter circuit filters and debounces the input voltage while the diode provides the reverse protection function.

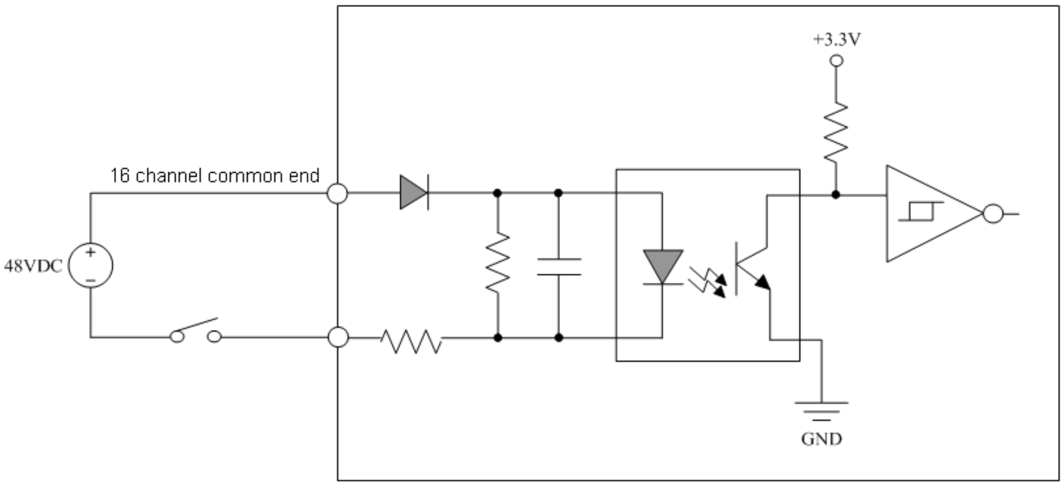


Figure 11.27: LK652 Channel Interface Circuit

11.3.3 Indicators Definition

RUN indicator (Green)	On	Communication is established, module in normal operation
	Flash	Communication is not established, communication error or module is disabled
	Off	Power off of the module
Channel01~16 Indicators (Yellow)	On	The channel is connected
	Off	Channel is disconnected

Table 11.9: Definition of LK652 Indicators

Specifications of RUN green light are as follows:

- After the power is on, the module waits for initialization data while the green light flashes with a frequency of 4 times/second.
- After the initialization is completed, the green light is constantly on to indicate the module in normal operation; if any error occurs in the initialization, then the communication is not established and the green light keeps flashing. Then, communication parameter settings shall be checked.
- Green light is constantly on in normal communications; green light flashes when communication breaks; green light returns to constant on when communication re-established.
- After LK652 is disabled, green light flashes at a frequency of 4 times / second.

11.3.4 Wiring Specifications

LK652 adopts 16 channels of dry contacts; therefore a field power supply is needed to drive the optical coupler. To ensure the isolation between field and system, this 48VDC field power supply shall be separated from the backplane power supply.

LK652 is a high-speed module that can be only installed on local backplanes. The local backplanes support two types of wrings: terminal wiring and prefabricated cable wring.

Wiring to Backplane Terminals

- LK652 module is connected to field signals through the correspondence terminals under the local backplane installation slot. The relationship between each channel and terminal is shown in Figure 11.28. One ends of the 16 channel contacts connect to the wiring terminals (01~16) of the correspondence channels while the other ends connect to the negative end of field power supply.

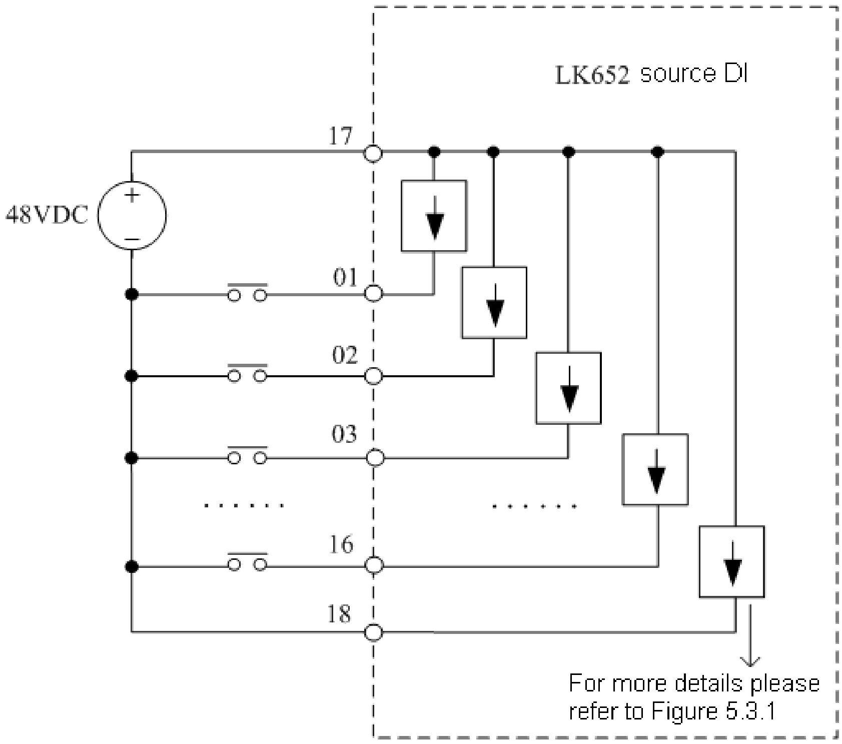


Figure 11.28: LK 652 Channel Interface of 16 Digital Inputs

In the wiring, the following shall be noted:

- LK652 shall connect to a separated external 48VDC field power supply to ensure the electric isolation between the system and the field.
- The 48VDC field power supply is shared by all 16 channels.
- Terminal "1~16" are the dry contact digital input ends of Channel 1~16.
- Terminal "17" connects to the positive end of field power supply and is the module's internal common end of Channel 1~16.
- Terminal "18" connects to the negative end of field power supply for the field power loss detection.
- A single terminal shall not be connected to many wires; therefore multiple-point connection can be established through bus bar or transferring terminal board.

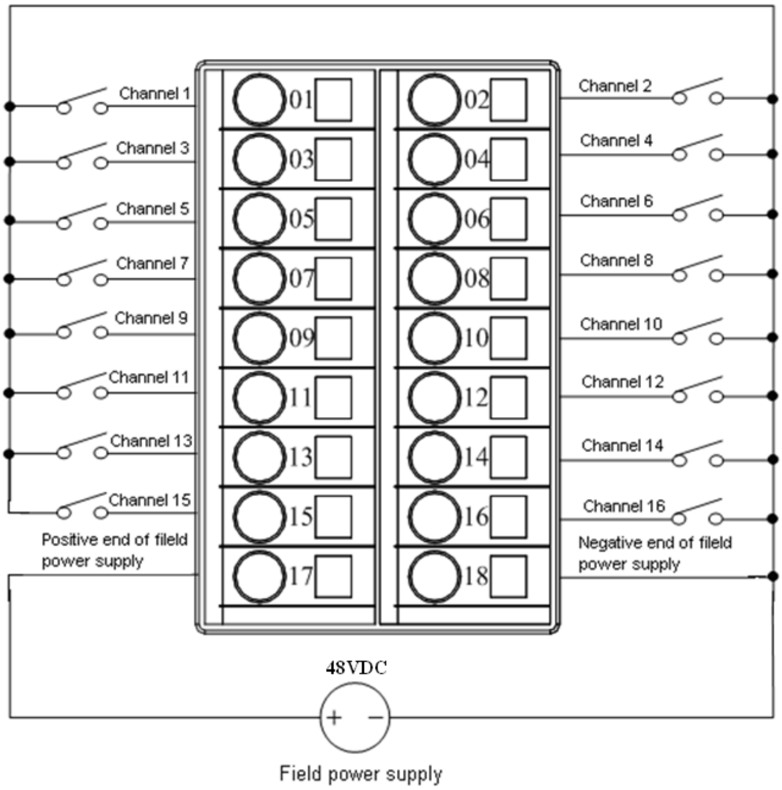


Figure 11.29: Wiring of LK652 Backplane Terminals

Wiring to Terminal Modules

Please refer to the information found on Chapter 12: Terminal Module.

11.3.5 Specifications of Diagnosis

In PowerPro V4 configuration software, the diagnosis functions are fulfilled by calling the expansion diagnosis library. For the high-speed modules, the high-speed bus diagnosis function block HS_LocalBusSlaveDiag in the diagnosis library HS_Diagnosis.lib shall be called to diagnosis the high-speed module on a local backplane slot (NodeID), as shown in Figure 11.30.

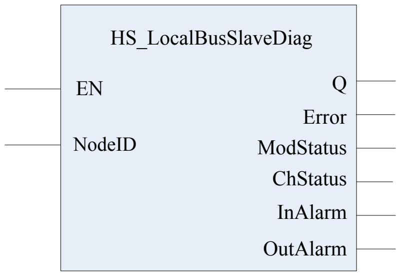


Figure 11.30: High-Speed Bus Diagnosis Function Block of PowerPro V4

The diagnosis library can provide diagnosis information about the operation and status of the module, its channels, and field power supply and module parameters. For detailed usage of High-Speed Diagnosis Function Block, please refer to LK Large Scale PLC Instruction Manual. Users shall note that the Diagnosis library is an external library that shall be first installed in the Library Manager before use.

Field Power Loss Detection

- LK652 provides field power loss detection. The power loss detection function is selectable through user parameter "FieldPowerLossDetection", the default value of which is "Enabled". Parameter changes can only be effective after a full download.
- As shown in Figure 11.31, terminal "17" connects to the positive end of field power supply while terminal "18" connects to its negative end.LK652 conducts the power loss detection by checking the changes of input voltage

between the two terminals. In case of any failure, the failure status will be reported to the controller as the diagnosis data.

- When the field power supply voltage is in the range of 30~60VDC, the optical coupler switch of power loss detection channel is "ON" to indicate that field power supply is normal; when the field power supply voltage is lower than 10VDC, the optical coupler switch of power loss detection channel is "OFF" to indicate the field power loss; when the field power supply voltage I sin the range of 10~30VDC, the status of the optical coupler switch is not determined.

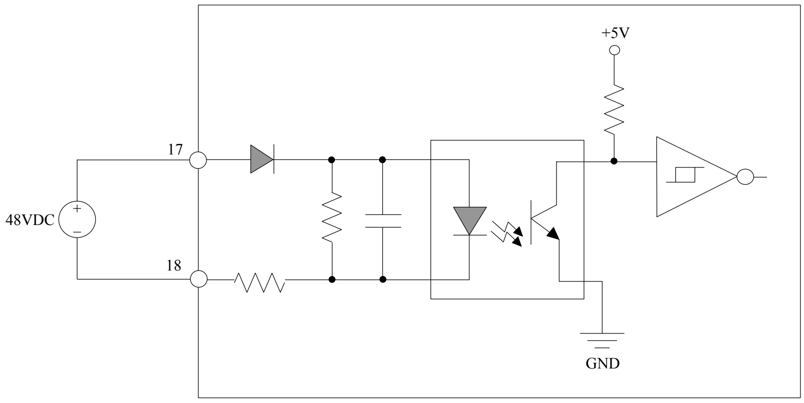
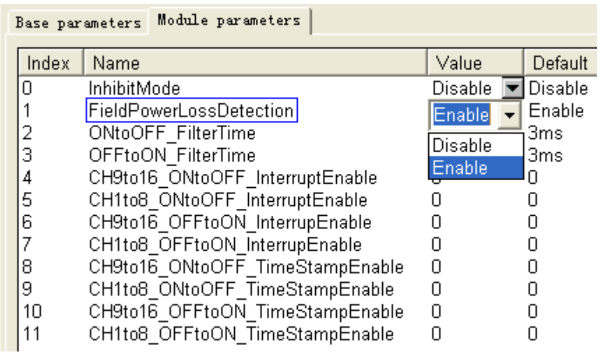


Figure 11.31: Field Power Loss Detection Circuit of LK652

- When the field 48VDC power supply is lost (disconnected or power supply voltage <10VDC), the device diagnosis data area of LK652 will generate diagnosis byte 0x28 and report it to the controller in the next scan period.
- When the field 48VDC power supply is recovered (power supply voltage 30~60VDC), the device diagnosis data area of LK652 will generate new diagnosis byte 0x20 and report it to the controller in the next scan period.
- LK652 only reports the diagnosis data once respectively when failure occurs and when the failure is recovered.


Base parameters | Module parameters

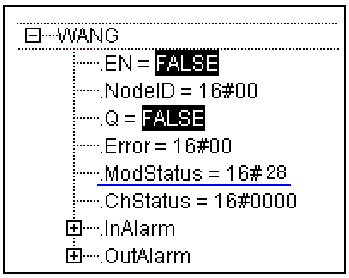
Index	Name	Value	Default
0	InhibitMode	Disable	Disable
1	FieldPowerLossDetection	Enable	Enable
2	ONtoOFF_FilterTime	Disable	3ms
3	OFFtoON_FilterTime	Enable	3ms
4	CH9to16_ONtoOFF_InterruptEnable		0
5	CH1to8_ONtoOFF_InterruptEnable	0	0
6	CH9to16_OFFtoON_InterrupEnable	0	0
7	CH1to8_OFFtoON_InterrupEnable	0	0
8	CH9to16_ONtoOFF_TimeStampEnable	0	0
9	CH1to8_ONtoOFF_TimeStampEnable	0	0
10	CH9to16_OFFtoON_TimeStampEnable	0	0
11	CH1to8_OFFtoON_TimeStampEnable	0	0

Figure 11.32: Enable Selection of LK652 Power Lost Detection

- Field power loss detection is a kind of device diagnosis. The definition of device diagnosis byte is shown in Figure 11.33. After the high-speed diagnosis function block is called, the diagnosis data reported by LK652 will be stored into device output end "ModStatus" of the function block, that is:

Field power loss: ModStatus=0x28

Field power loss recovery: ModStatus=0x20



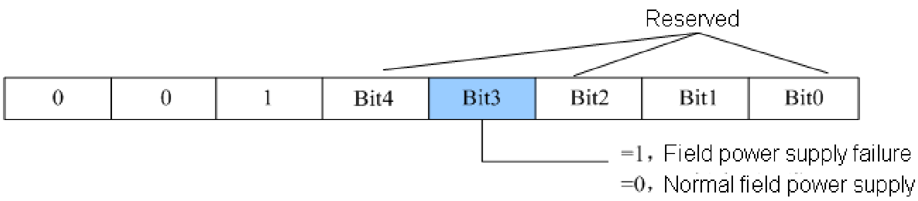
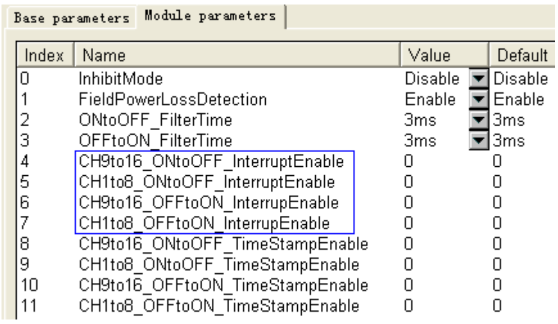


Figure 11.33: Definition of LK652 Device Diagnosis Byte

11.3.6 Function Specifications

Interrupts

- Each transition (ON→OFF or OFF→ON) of LK652 channel signals can be set as an event to trigger the operation of the correspondence user program segment in LK controller. This is the interrupt of LK652.
- LK652 selects whether to generate interrupts at the field signal transitions through user parameter (InterruptEnable). The default value of which is not to generate interrupt. The rising and falling edge transition interrupts of each channel are configured separately and differently.



Base parameters | Module parameters

Index	Name	Value	Default
0	InhibitMode	Disable	Disable
1	FieldPowerLossDetection	Enable	Enable
2	ONtoOFF_FilterTime	3ms	3ms
3	OFFtoON_FilterTime	3ms	3ms
4	CH9to16_ONtoOFF_InterruptEnable	0	0
5	CH1to8_ONtoOFF_InterruptEnable	0	0
6	CH9to16_OFFtoON_InterruptEnable	0	0
7	CH1to8_OFFtoON_InterruptEnable	0	0
8	CH9to16_ONtoOFF_TimeStampEnable	0	0
9	CH1to8_ONtoOFF_TimeStampEnable	0	0
10	CH9to16_OFFtoON_TimeStampEnable	0	0
11	CH1to8_OFFtoON_TimeStampEnable	0	0

Figure 11.34: Setting of LK652 interrupts

- On the LK local backplane, only the 4 I/O slots near the controller support interrupts. Therefore the LK652 module with its interrupts configured as enabled should be installed on these 4 slots.

Time Stamp

- LK652 provides Time Stamp function to record the Coordinated System Time (CST) of the status change in a channel. Coordinated system time is the system time maintained by the controller to synchronize the high-speed I/O modules on the local backplane. CST is recorded by an 8 bytes clock timer in the unit of microsecond (μs). Since the maximum recording range is 264 microseconds (more than 500 thousand years), there is no need to consider timer exceeding when the system is put into operation.
- Adding a time stamp means writing the coordinated system time of the transition moment into the module's time stamp register. Then the time stamp value and DI signals are uploaded to the controller together through the high speed bus.
- In one scan period, one module can only sent one time stamp to the controller. Therefore, it is suggested to enable the time stamp function in only one channel of one module. If more than one channel in a module enabled the time stamp function at the same time, then only the time stamp value of the last transition in one scan period will be uploaded.
- LK652 sets whether to add time stamp at the moment of field signal transition through user parameter "TimeStampEnable", the default value of which is "not add time stamp". Whether to add time stamp at rising edge and falling edge transitions are configured separately and differently in each channel. Only when the time stamp function is enabled in one of its channels, LK652 will record and upload time stamp value.
- Time stamp value consists of 8 BYTE type variables that it can be divided into Timestamp8~Timestamp1 according to the sequence of hexadecimal high byte to low byte.

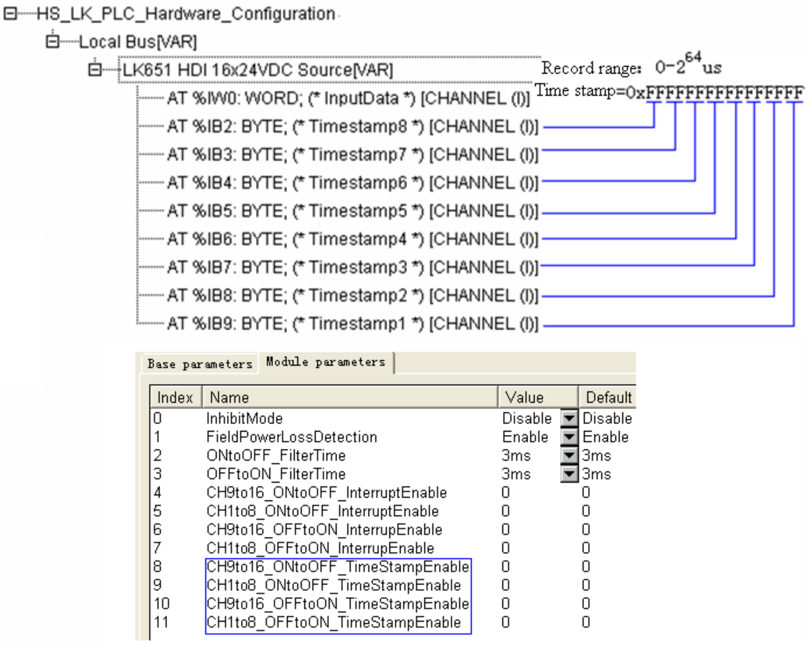


Figure 11.35: Setting of LK652 Time Stamp Function

Module Inhibition

- Module inhibition function forces slave station module get off the control of user program so that the module will be considered as not existed by the controller. An inhibited LK652 module receives the initialization data sent by the controller, but does not communicate with the controller, report diagnosis information or upload data. The inhibition function is only effective after a full download. The input area is cleared after the full download, so the input value is always 0.
- When the module is inhibited, its "RUN" light flashes.
- Whether to inhibit the module is selected by user parameter "Inhibit Mode", the default value of which is "Disable".

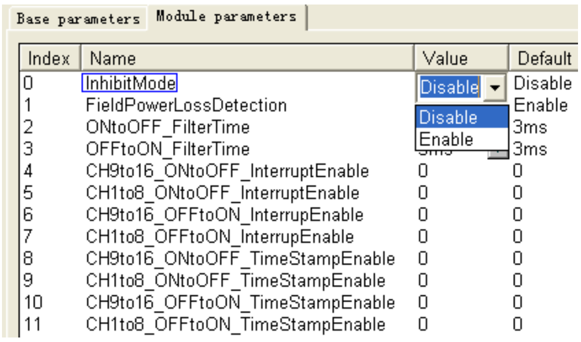


Figure 11.36: Module Inhibition Setting of LK652

Reverse Protection

- LK652 connects a diode in series at the power input positive end for the reverse protection. It protects the internal circuit from any damages when there is wrong connection of the field power positive and negative ends.

11.3.7 Parameter Specifications

Activation of high-speed local bus consists of three steps: parameter initialization, configuration and data exchange. The controller can only read and write the high-speed I/O information regularly after it entered data exchange mode. Therefore, in order to provide correct parameter information in the initialization process, users shall first set the parameters in the configuration software.

Communication Parameters

- Communication address is the node number of high-speed module and controller communication. A unique communication address is assigned to each high-speed module in the bus link. If there is any error of the communication address, the slave station module will not be able to establish communication with the controller.
- LK652 high-speed module is installed on the local backplane. Its unique communication address is determined by the slot number of LK652. *Refer to Chapter 2: Backplanes for the detailed assignment of communication address.*

- When a high-speed module is added in the configuration, it will have a default "Node ID". This ID is not the correct communication address of the high-speed module (determined by the slot number), but only an address assigned automatically by the software according to the adding order.
- As shown in Figure 11.37, the correct communication address shall be re-assigned for each high-speed module in the "NodeID" field of "Basic Parameter". Other parameters keep their default value and do not need modification.
- After adding or deleting high-speed module in configuration or re-locating the slot of high-speed module on the backplane, the communication address in the "NodeID" shall be checked to ensure it is still correct.

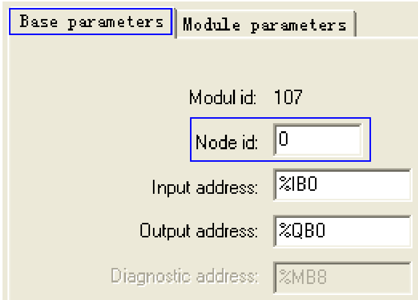


Figure 11.37: Setting of LK652 Communication Address

User Parameters

- There are three ways to process field signals in LK652:
  - Interrupts: When a transition occurs in the field DI signal, an interrupt is generated.
  - Time stamp: When a transition occurs in the field DI signal, a time stamp is added.
  - Module inhibition: Collect field DI signals but do not upload.
- Whether to generate an interrupt, add a time stamp or inhibit, the module is configured through module parameters. Module parameters are used to configure the module's operating mode. They are written into the controller during the download of user program and will not be read in every scanning circle. Each parameter has a default value that can be changed according to requirements of the project. Module parameters do not support online modifications; therefore they can only be effective after the full download.
- As shown in Table 11.10, module parameters include module inhabitation, software filter time; interrupt enabling, power loss detection enabling and time stamp enabling.

Parameter Name	Parameter Definition
InhibitMode	Whether the module is inhibited =Disable, not inhibited (default) =Enable, inhibited
FieldPowerLossDetection	Field Power Loss Detection =Enable, the function is enabled (default); =Disable, the function is disabled;
ONtoOFF_FilterTime	ON→OFF software filter time =00, 0ms =01, 0.1ms =02, 0.5ms =03, 3ms (Default) =04, 20ms
OFFtoON_FilterTime	OFF→ON software filter time =00, 0ms =01, 0.1ms =02, 0.5ms =03, 3ms (Default) =04, 20ms
IN9to16_ONtoOFF_InterruptEnable	Whether ON→OFF transitions in channels from 9 to 16 generate interrupts Value range: 0 (default) ~255 bit 0 (0 corresponds to channel 9) =0, ON→OFF transitions in channel 9 do not generate interrupts (default) =1, ON→OFF transitions in channel 9 generate interrupts Similarly for bit 1 (channel 10) ~ bit 7 (channel 16)
IN1to8_ONtoOFF_InterruptEnable	Whether ON→OFF transitions in channels from 1 to 8 generate interrupts Value range: 0 (default) ~255

	bit 0 (corresponds to channel 1) =0, ON→OFF transitions in channel 1 do not generate interrupts (default) =1, ON→OFF transitions in channel 1 generate interrupts Similarly for bit 1 (channel 2) ~ bit 7 (channel 8)
IN9to16_OFFtoON_InterruptEnable	Whether OFF→ON transitions in channels from 9 to 16 generate interrupts Value range: 0 (default) ~255 bit 0 (corresponds to channel 9) =0, OFF→ON transitions in channel 9 do not generate interrupts (default) =1, OFF→ON transitions in channel 9 generate interrupts Similarly for bit 1 (channel 10) ~ bit 7 (channel 16)
IN1to8_OFFtoON_InterruptEnable	Whether OFF→ON transitions in channels from 1 to 8 generate interrupts Value range: 0 (default) ~255 bit 0 (corresponds to channel 1) =0, OFF→ON transitions in channel 1 do not generate interrupts (default) =1, OFF→ON transitions in channel 1 generate interrupts Similarly for bit 1 (channel 2) ~ bit 7 (channel 8)
IN9to16_ONtoOFF_TimeStampEnable	Whether ON→OFF transitions in channels from 9 to 16 add time stamps Value range: 0 (default) ~255 bit 0 (corresponds to channel 9) =0, channel 9 does not add time stamp (default) =1, channel 9 adds time stamp Similarly for bit 1 (channel 10) ~ bit 7 (channel 16)
IN1to8_ONtoOFF_TimeStampEnable	Whether ON→OFF transitions in channels from 1 to 8 add time stamps Value range: 0 (default) ~255 bit 0 (corresponds to channel 1) =0, channel 1 does not add time stamp (default) =1, channel 1 adds time stamp Similarly for bit 1 (channel 2) ~ bit 7 (channel 8)
IN9to16_OFFtoON_TimeStampEnable	Whether OFF→ON transitions in channels from 9 to 16 add time stamps Value range: 0 (default) ~255 bit 0 (corresponds to channel 9) =0, channel 9 does not add time stamp (default) =1, channel 9 adds time stamp Similarly for bit 1 (channel 10) ~ bit 7 (channel 16)
IN1to8_OFFtoON_TimeStampEnable	Whether OFF→ON transitions in channels from 1 to 8 add time stamps Value range: 0 (default) ~255 bit 0 (corresponds to channel 1) =0, channel 1 does not add time stamp (default) =1, channel 1 adds time stamp Similarly for bit 1 (channel 2) ~ bit 7 (channel 8)

Table 11.10: Definition of LK652 User Parameters

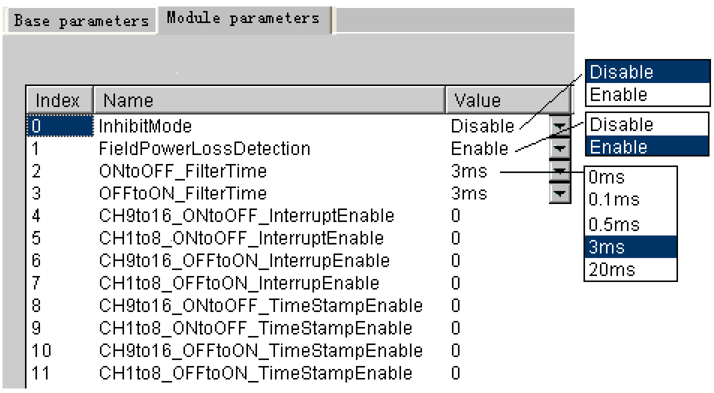


Figure 11.38: LK652 module parameters

Specifications of Data Area

Input data is the data the will be uploaded from slaves during every scan period. Output data is the data that the controller distributes to slaves during every scan period. When the user program is running, such data can be modified online.

During each scan period, LK652 uploads 2 bytes of channel measurement data and 8 bytes of time stamp data to the controller, as shown in Table 11.11.

Input Data	Definition
InputData	Channel measurement data (0x0000 ~ 0xFFFF)
TimeStamp8	Time stamp high byte (0x00~0xFF)
TimeStamp7~2	Time stamp middle byte (0x00~0xFF)
TimeStamp1	Time stamp low byte (0x00~0xFF)

Table 11.11: LK652 input and output data definitions

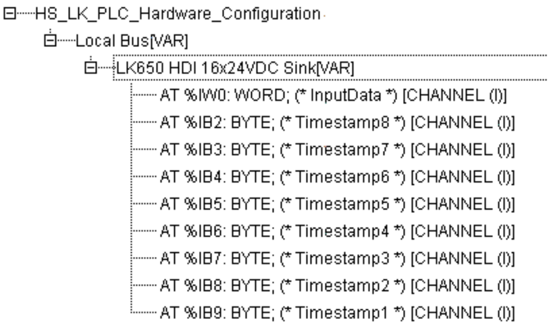


Figure 11.39: LK652 Input/Output Data Interface

11.3.8 Module Installation and Un-installation

Refer to chapter 1 on “Module Insertion Mechanical keys” and “Module Insertion and Removable” for more details.

11.3.9 Technical Specifications

LK652 48VDC 16-Channel Source High Speed DI Module		
System Power Supply		
System Power Supply Voltage		24VDC (-15% ~ 20%)
System Power Consumption		50mA max@24VDC, exclusive of field power consumption
Input Channel		
Number of Channels		16
Contact Point Type		Dry contact, source input
Field Power Supply Rated Voltage		48VDC
Channel Closure Rated Voltage		5mA@48VDC
Threshold voltage Level(Vth)	ON	30VDC（2mA）~60VDC（7mA）
	OFF	10~10VDC（1.5mA）
Debounce filter time OFF→ON ON→OFF		 0ms/0.1ms/0.5ms/3ms/20ms, hardware delay: 15µs~30µs 0ms/0.1ms/0.5ms/3ms/20ms, hardware delay: 30µs~45µs
Reverse Protection		Maximum Voltage 60VDC
Isolation Voltage between Field and System		500VAC@1min, Current Leak 5mA
Failure Diagnosis and Hot Swamp		
Field power loss diagnosis		When field power is lost, the reported diagnosis byte is 0x28; when power is restored, 0x20 is reported, and only reported once.
Hot Swap		Support
Communication Bus		
Protocol		HollySys proprietary protocol
Baud Rate		32Mbps
Media		Communication bus is connected to the backplane through euro connector
Physical Features		
Mechanic Keys to Prevent Incorrect Insertion		D1
Installation		Only supports local backplanes. When set as interrupt mode, can only be installed in the 4 slots closest to the controller.
Dimensions		Width × Height × Depth = 35mm×100mm×100mm
Casing Protection Level		IEC60529 IP20
Weight		185g
Working Environment		
Working temperature		0~60°C
Working Relative Humidity		5%~95%, no condensate
Storage Temperature		-40~70°C
Storage Temperature		5%~95%, no condensate

Table 11.12: Technical Index of LK652 Module

11.4 LK750 16-CHANNEL 24VDC HIGH-SPEED SOURCE DI MODULE

11.4.1 Features

- 16 channels, source MOSFET output
- Output voltage: 10VDC~31.2VDC
- Supports 32Mbps high-speed local bus
- Fault Mode Output
- Programming mode output
- Module inhibition function
- Scheduled output
- Field Power Loss Detection
- Over-Current Protection
- Installation only on local backplanes
- System-to-Field Isolation
- Supports hot swap

11.4.2 Operation Principles

As shown in Figure 11.40, one end of the load is connected to the negative of the field power supply, and the other end is connected to LK750. When the MOSFET electronic switch is closed, the current from the switch provides power to the load, and the 16 switches share the same power supply inside the module.

The controller writes the output data and the time of prefabrication into the memory of LK750 through a high-speed bus. The output data controls the open and close instructions of the MOSFET electronic switch. When the level of the control signal is high, the Light Emitting Diode (LED) side of the optical coupler is connected, and digital output is achieved.

The diode is used to continue the current. When the external load is inductive, it is used for releasing the inductive current at the moment of power off.

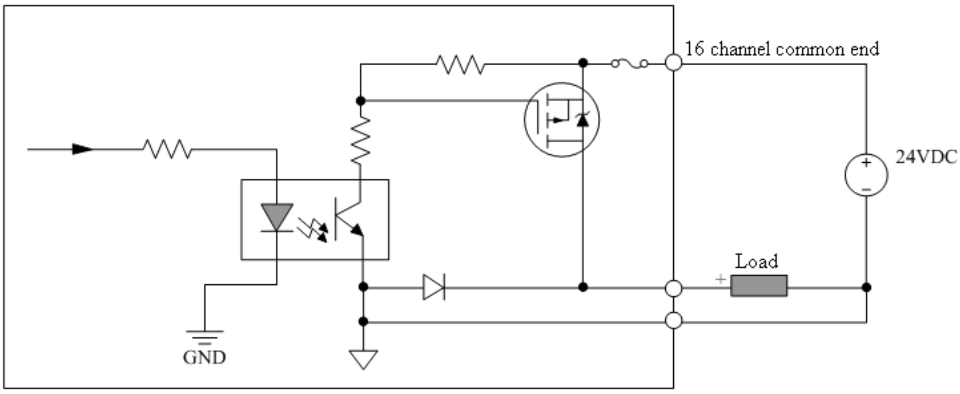


Figure 11.40: LK750 Channel Interface Circuit

11.4.3 Indicators Definition

RUN indicator (Green)	On	Communication is established, module in normal operation
	Flash	Communication is not established, communication error or module is disabled
	Off	Power Off or Module Failure
Channel01~16 Indicators (Yellow)	On	The channel is connected
	Off	The channel is open or there is no output

Table 11.13: Definition of LK750 Indicators

Specifications of RUN green light are as follows:

- After the power is on, the module waits for initialization data while the green light flashes with a frequency of 4 times per second.
- After the initialization is completed, the green light is constantly on to indicate the module in normal operation; if any error occurs in the initialization, then the communication is not established and the green light keeps flashing. Then, setting s of communication parameters (slave station address, etc) shall be checked.
- Green light is constantly on in normal communications; green light flashes when communication breaks; green light returns to constant on when communication re-established.
- After LK750 is disabled, green light flashes at a frequency of 4 times / second.

11.4.4 Wiring Specifications

LK750 needs field power supply to driver its load. To ensure the isolation between field and system, this 24VDC field power supply shall be separated from the backplane power supply.

LK750 is a high-speed module installed on local backplanes. The local backplanes support two types of wrings: terminal wiring and prefabricated cable wring.

Wiring to Backplane Terminals

- LK750 module is connected to field signals through the correspondence terminals under the local backplane installation slot. The relationship between each channel and terminal is shown in Figure 11.41. One ends of the 16 channel loads connect to the wiring terminals (01~16) of the correspondence channels while the other ends connect to the negative end of field power supply.

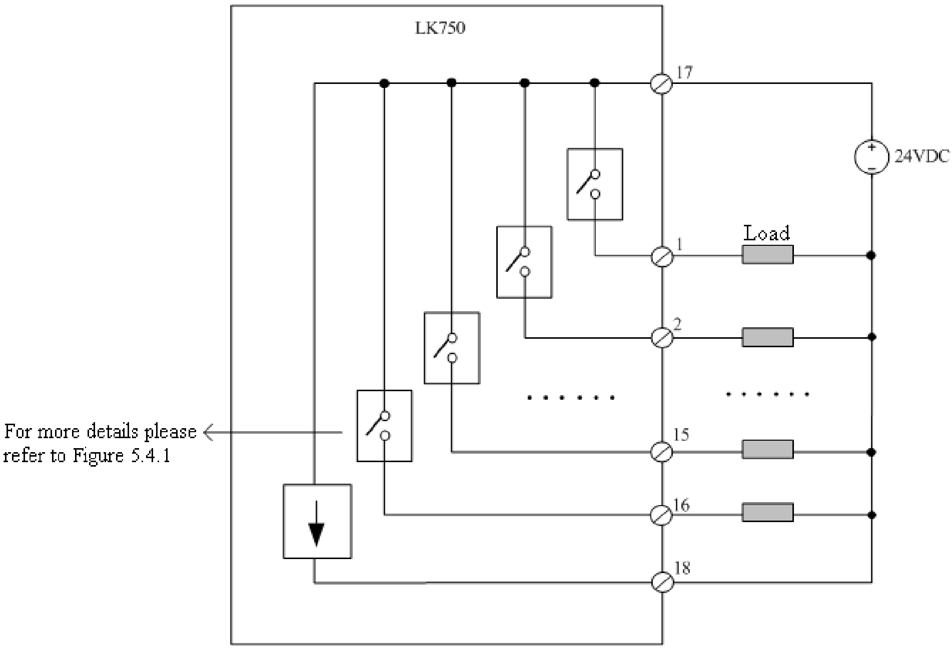


Figure 11.41: LK750 Channel Wiring to Backplane Terminals

In the wiring, the following shall be noted:

- Modules do not have reverse voltage protection. If the wiring is done wrongly, internal circuitry may be burnt.
- External separated 24VDC field power supply.
- Terminal "1~16" are the transistor digital output ends of channels 1~16 respectively.
- The terminal "17" is the positive of field power supply shared by the 16 DO signals.
- The terminal "18" is connected to the negative of field power supply.
- A single terminal shall not be connected to many wires; therefore multiple-point connection can be established through bus bar or transferring terminal board.

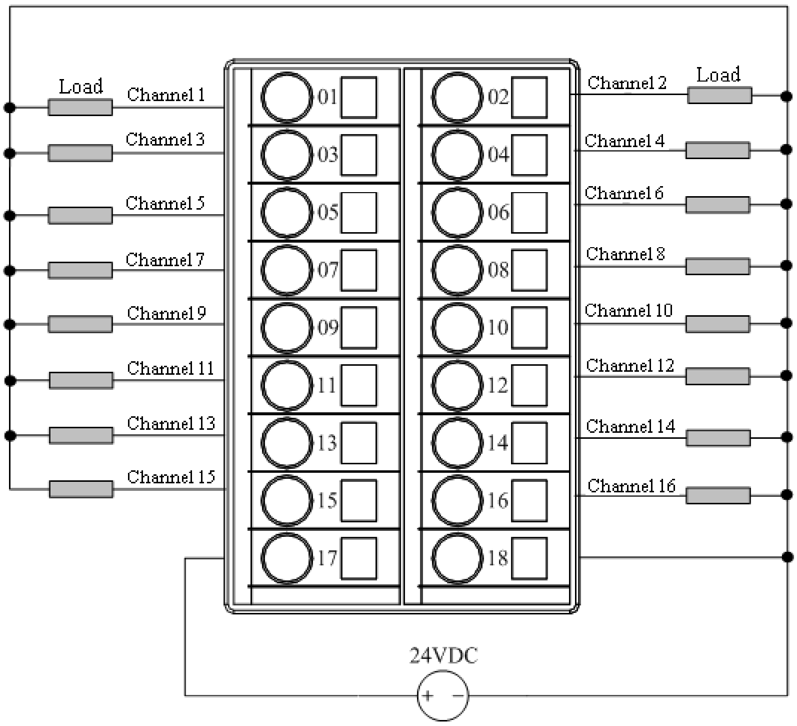


Figure 11.42: Wiring of LK750 Backplane Terminals

Wiring to Terminal Modules

Please refer to the information found on Chapter 12: Terminal Module.

11.4.5 Specifications of Diagnosis

In PowerPro V4 configuration software, the diagnosis functions are fulfilled by calling the expansion diagnosis library. For the high-speed modules, the high-speed bus diagnosis function block HS_LocalBusSlaveDiag in the diagnosis library HS_Diagnosis.lib shall be called to diagnosis the high-speed module on a local backplane slot (NodeID), as shown in Figure 11.43.

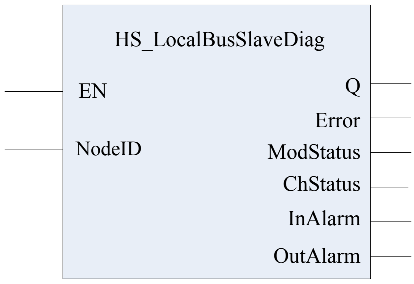


Figure 11.43: High-Speed Bus Diagnosis Function Block of PowerPro V4

The diagnosis library can provide diagnosis information about the operation status of the module internals, its channels, field power supply and module parameters, information about module types and whether there are errors in the channel. For detailed usage of High-Speed Diagnosis Function Block, please refer to LK Large Scale PLC Instruction Manual.

Users shall note that the Diagnosis library is an external library that shall be first installed in the Library Manager before use.

Field Power Loss Detection

- LK750 provides field power loss detection. The power loss detection function is selectable through user parameter “FieldPowerLossDetection”, the default value of which is “Enabled”. Parameter changes can only be effective after a full download.
- Terminal “17” connects to the positive of field power supply while terminal “18” connects to its negative.LK750 conducts the power loss detection by checking the changes of input voltage between the two terminals. In case of any failure, the failure status will be reported to the controller as the diagnosis data.

- When the field 24VDC power supply is lost (disconnected or power supply voltage <5VDC), the device diagnosis data area of LK750 will generate diagnosis byte 0x48 and report it to the controller in the next scan period.
- When the field 24VDC power supply is recovered (power supply voltage 10~31.2VDC), the device diagnosis data area of LK750 will generate new diagnosis byte 0x40 and report it to the controller in the next scan period.
- LK750 module will only report the diagnosis data once respectively when failure occurs and is recovered.

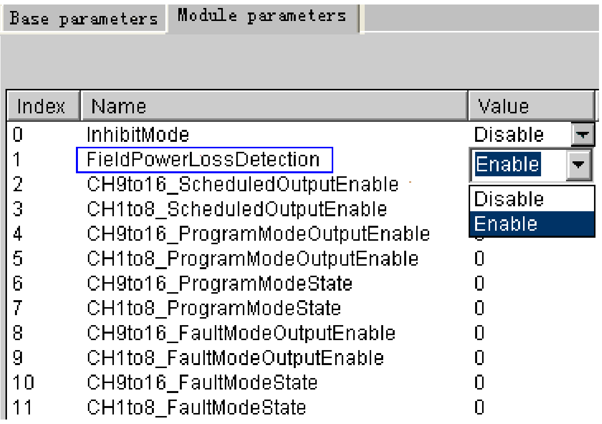
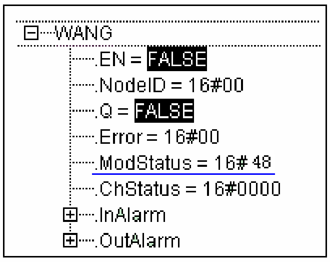


Figure 11.44: Enable Selection of LK750 Power Lost Detection

- Field power loss detection is a kind of device diagnosis. The definition of its diagnosis byte is as shown in Figure 11.45. After the high-speed diagnosis function block (HS_LocalBusSlaveDiag) is called, the diagnosis data reported by LK750 will be stored into the output "ModStatus" of the function block, that is:

Field power loss: ModStatus=0x48

Field power loss recovery: ModStatus=0x40



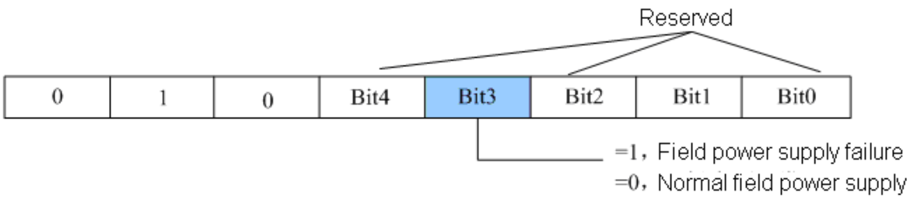


Figure 11.45: Definition of LK750 Device Diagnosis Byte

11.4.6 Function Specifications

Scheduled output

- The scheduled output function is to implement a delayed feedback control, where the DO output is controlled by the transition of the field DI signal. After a DI trigger event happens, DO is output after some delay, as shown in Figure 11.46.

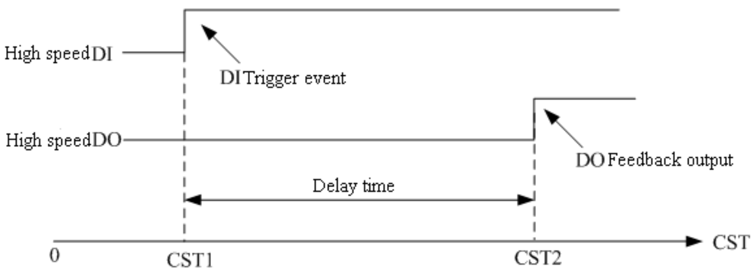


Figure 11.46: Delay sequence diagram

- LK750 has a scheduled output function, which can record the CST time stamp for high speed transitions (ON→OFF or OFF→ON), and output to the channel after some delay. The period of delay is called the delay time, which is specified by the users and has a maximum value of 16.7s.

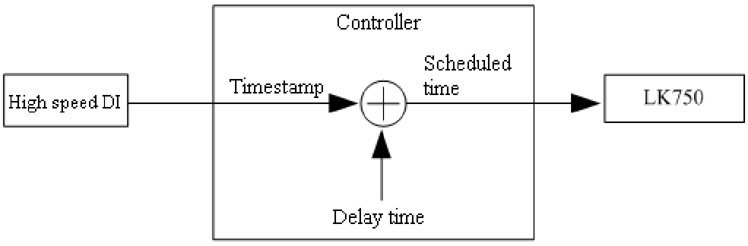


Figure 11.47: Prefabrication function implementation

- After the scheduled output function is enabled, LK750 will receive a 3 byte time data sent by the controller, which is called the Scheduled Time. The scheduled time is computed by adding the time stamp and the delay time in the configuration algorithm. The method of computations is: scheduled time equals to DI time stamp (8 bytes) plus the delay time, and the 3 least significant bytes of the sum is taken as the result.
- The controller sends the scheduled time and the output instruction together to LK750, and after that non-scheduled output channels will output the control instruction immediately, whereas the scheduled output channel will not execute the output instruction immediately. LK750 compares the 3 least significant bytes of the current CST with the scheduled time, and the output instruction is executed on the scheduled output channel only when they are the same.
- The delay time is in microseconds (μs), which is consistent with the unit of CST. In the configuration algorithm, the delay time is a 3 byte value, whose decimal value 0~16777215 represents 0~16777215 μs time delay.
- When the controller exchanges data with high-speed modules, there is a minimum query period. In PowerPro V4 configuration software, the time interval to execute user programs, which is the task period, must be exact multiples of the minimum query period. The controller executes IEC computation once every other task period.

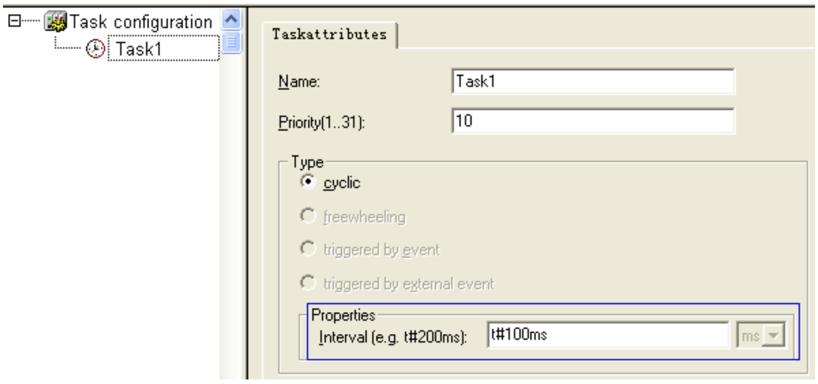


Figure 11.48: Task period setting in configuration software

- The delay time cannot be smaller than the task period, otherwise the controller will not be able to compute the schedule time in the next computation period before the delay time elapses. That is, the sum of the time stamp and the delay time must be later than the CST time when the scheduled time is sent, otherwise the scheduled time will not be accurate, and the required delay of output cannot be achieved.
- Different models of controllers may have different minimum query periods when they communicate with high-speed modules. For example, the minimum query periods of LK210 and LK209 are both 50ms, and the minimum query period of LK207 is 10ms. For details, please refer to the controller manual.
- It is not difficult to see from the above that CST is crucial in the scheduled output. What exactly is CST? We will briefly describe it in the following.
- The Coordinated System Time, or CST, is counted by an 8-byte counter, where the counter counts in microseconds (μs), and can record a maximum of 264 microseconds (more than 500,000 years). Therefore, counter overflow does not need to be concerned after the system is put into production. All high-speed I/O modules maintain the same coordinated system time, and are synchronized by the controller. The CST is a relative time with a precision of microsecond shared by the controller and high-speed I/O.
- Scheduled output can be configured separately for individual channels. When some channels are configured with scheduled outputs and some are not, the scheduled output channels will delay for a scheduled time when responding to output commands from the controller. Non-scheduled output channels will respond to output commands from the controller in real-time. It should be noted that all scheduled output channels share the same scheduled time.
- After scheduled output is enabled, the output channel will only output data when the scheduled time arrives. Channels 1~8 can be configured to use scheduled output using the user parameter "CH1to8ScheduledOutputEnable"; channels 9~16 can be configured to use scheduled output using parameter "CH9to16ScheduledOutputEnable". The default for these parameters is that scheduled output is not enabled (Disable). As shown in Figure 11.49, the machine code for scheduled time, 0x000000~0xFFFFFF, consists of 3 byte variables, namely, ScheduledTime_H, scheduledTime_M, and ScheduledTime_L.

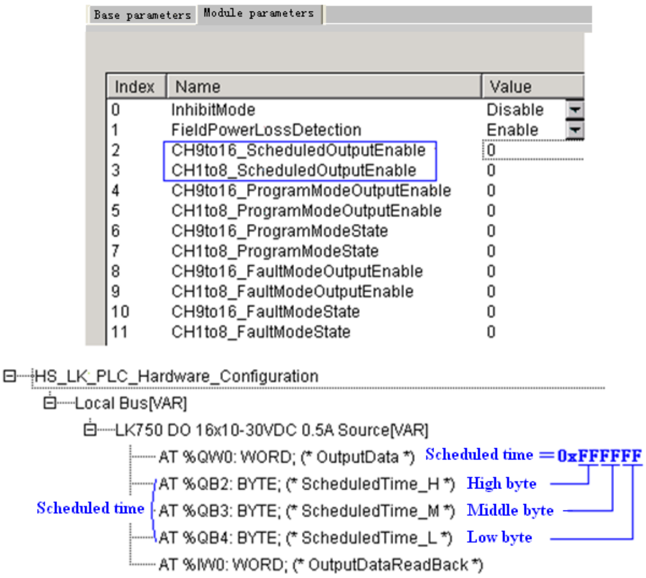


Figure 11.49: LK750 scheduled output settings

- When writing user programs, scheduled time can be set using the scheduled output function block "HS_ScheduledTime". Enter the required delay time after specifying the communication addresses of high-speed input modules and high-speed output modules, and the function block will automatically compute the scheduled time, which will be output to high-speed output modules, as shown in Table 11.14. For details of this function block, please refer to the LK Large Scale Programmable Logic Controller Instruction Manual.
- It is worth noting that, the input channels of high-speed DI modules will only upload time stamps after time stamps are enabled, and will only upload the time stamps for one channel during each scan period. The function block will automatically read the time stamps for the channel, and compute the scheduled time, which is then output to the high-speed DO modules. Hence, when configuring high-speed DI modules, only enable time stamps of the DI channels are used to trigger scheduled output.

HS_ScheduledTime Inputs: EN, NodeID_HDI, NodeID_HDO, ScheduledTime Outputs: Q, Error			
Input Parameter	Functions Description	Parameter Specifications	Default Value
NodeID_HDI	Address of high-speed input module	Valid module addresses: 2~14	0
NodeID_HDO	Address of high-speed output module	Valid module addresses: 2~14	0
ScheduledTime	Time of delay	Unit: microsecond µs (1 to 16 777 215 µs) It is required that ScheduledTime>IEC task period + 10000µs.	1000000
Output Parameter	Functions Description	Parameter Specifications	Default Value
Error	Error messages	0: correct Non-0: error .0=1, input module address error .1=1, output module address error .2=1, delay time input error .3=1, data are pointer seeking address error	0

Table 11.14: Scheduled output function block

Enable Output

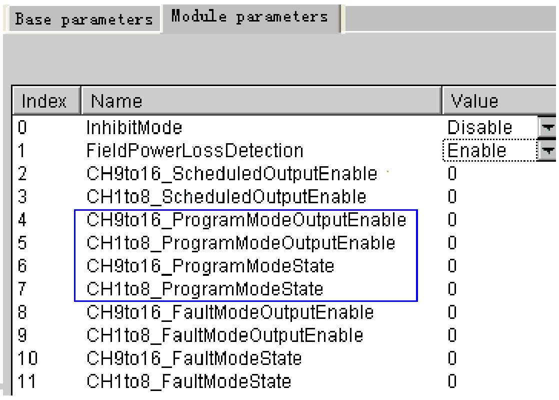
- After the output module is power on, if it does not receive any output instruction from the controller, it will keep the initial mode and does no output. The output of an initial mode module is disabled. In this case, the module will keep this initial mode even it enters programming mode or failure mode.
- After the operation of user programs, the controller sends output instruction to the output module through PROFIBUS-DP bus. Output module receives instruction and outputs data. The output of a slave module enable once the module outputs an instruction sent by the controller. When the module output is enable, in case the module enters programming mode or failure mode, it will output values of programming mode or failure mode.
- In short, whether the module output is enabled will affect its output status under failure mode and programming mode.
- If the module is hot-swamped or turned on again after power loss after its output is enable, it will return back to the initial status and the output is disabled again. The output will be enabled again once the module receives another output instruction from the controller.
- After a full-download, the user program in the controller stops operation and the slave module enters programming mode automatically. In this case, if the module output is enabled before the download, it will output the programming mode value; if the module output is disabled before the download, it will keep the initial status.
- After the full-download, the user program operation can be executed through the following two methods:
- Turn the key switch on controller front-panel to “RUN”.
- Turn the key switch on controller front-panel to “REM” and execute “Operation” command in the programming software.

Over-Current Protection

- LK750 has an over-current protection function, which protects the module when the instantaneous current is too large, such as in the case of output short circuit. The over-current protection is achieved by connecting self-recovering fuses in series in the channel circuit, and every two points share a self-recovering fuse.

Program Mode

- Program mode is the operating mode of the controller to modify, edit and download user programs. In program mode, user programs are halted and cannot be restarted through programming software. Not under control, output module retains output or outputs a state (ON or OFF) preset in the configuration, known as the Program Mode State.
- Controller can make the slave station into or out of program mode through the following methods:
- Turn the key switch to “PRG” to force all output modules into program mode. Then, operation of user program halts, LK750 outputs program mode state.
- Turn the key switch to “RUN”, slave station gets out of program mode and controller runs the user program, the output is enabled.
- Please note that if the module has never been output enabled, it does not output programming mode state even it enters the program mode.
- After the full-download of user program, output module automatically enters program mode no matter whether the controller key switch is located at “PRG”. If the output module has never output any data before the download (i.e., output is not enabled), it will retain the initial status and does not output. If the module output has been enabled before the download, the module outputs program mode state.
- Under program mode, whether the module retains output or outputs program mode state is configured by the user parameter “ProgramModeOutputEnable”, whose default value is to hold the output state. Program mode state is configured by user parameter “ProgramModeState”, default output is OFF (disconnected). Parameters of each channel are configured separately without interfering others. Modified parameters will only be effective after a full download. Special notes shall be taken that: after the full down and before the operation, the module is under programming mode and outputs previous program mode state. The new value will only replace the previous one after the operation of user program.



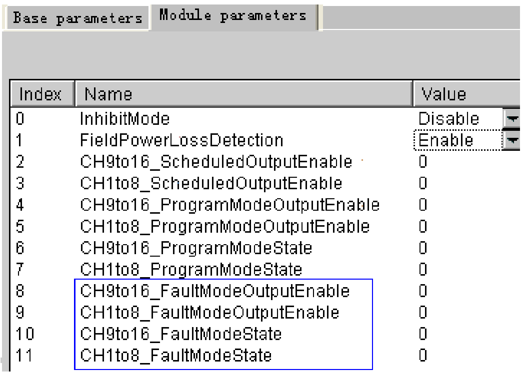
Base parameters | Module parameters

Index	Name	Value
0	InhibitMode	Disable
1	FieldPowerLossDetection	Enable
2	CH9to16_ScheduledOutputEnable	0
3	CH1to8_ScheduledOutputEnable	0
4	CH9to16_ProgramModeOutputEnable	0
5	CH1to8_ProgramModeOutputEnable	0
6	CH9to16_ProgramModeState	0
7	CH1to8_ProgramModeState	0
8	CH9to16_FaultModeOutputEnable	0
9	CH1to8_FaultModeOutputEnable	0
10	CH9to16_FaultModeState	0
11	CH1to8_FaultModeState	0

Figure 11.50: LK750 Output Setting under Program Mode

Communication Failure

- When communication failure occurs, the communication between controller and output module is broken and the "RUN" light flashes. The module may be in one of the following states in communication failure:
- After power on, module cannot establish communication with the controller, then LK750 will retain the initial status and its output is not enabled.
- Module in operation when communication failure occurs: module retains output or outputs a state (ON or OFF) preset in the configuration, known as the Fault Mode State (FaultModeState). Whether the module retains output or outputs fault mode state can be configured in software.
- Communication failure occurs in program mode: LK750 enters fault mode automatically and outputs the fault mode state. When recovered from failure, the module returns to the program mode and outputs program mode state again with the "RUN" indicator constantly on.
- If the module output has not been enabled, the module does not output fault mode state even if communication failures occur.
- Under fault mode, whether the module retains output or outputs the fault mode state is configured by the user parameter "FaultModeOutputEnable", whose default value is to hold the output state. Fault mode state is configured by user parameter "FaultModeState", and the default is to output OFF (disconnected).Parameters of each channel are configured separately without interfering others.



Base parameters | Module parameters

Index	Name	Value
0	InhibitMode	Disable
1	FieldPowerLossDetection	Enable
2	CH9to16_ScheduledOutputEnable	0
3	CH1to8_ScheduledOutputEnable	0
4	CH9to16_ProgramModeOutputEnable	0
5	CH1to8_ProgramModeOutputEnable	0
6	CH9to16_ProgramModeState	0
7	CH1to8_ProgramModeState	0
8	CH9to16_FaultModeOutputEnable	0
9	CH1to8_FaultModeOutputEnable	0
10	CH9to16_FaultModeState	0
11	CH1to8_FaultModeState	0

Figure 11.51: LK750 Fault Mode State Setting

Module Inhibition

- Module inhibition function forces slave station module get off the control of user program so that the module will be considered as not existed by the controller. The inhibited LK750 module receives the initialization data sent by the controller, but does not communicate with the controller, report diagnosis information or upload data. When the module is inhibited, its "RUN" light flashes.
- The inhibition function is only effective after a full download. After the full download, the module enters program mode automatically. If the LK750 module has never output any data before the download (e.g. output is not enabled), it will retain the initial status and does not output. Otherwise the inhibited LK750 outputs the program mode state.
- Whether to inhibit the module is selected by user parameter "InhibitMode", the default value of which is "Disable".

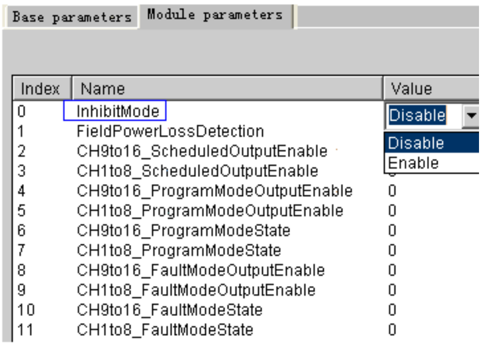


Figure 11.52: Module Inhibition Setting of LK750

11.4.7 Parameter Specifications

In order to provide correct parameter information in the initialization process, users shall first set the hardware parameters in the configuration software PowerPro V4.

As shown in Figure 11.53, in the PLC configuration, choose “Local Bus” high-speed backplane bus link, add “LK750 HDO 16x10-30VDC 0.5A Source” in the Local Bus link, and hard parameters can be configured for LK750. The hardware parameters can be configured with LK750 module includes communication parameters and user parameters. The specifications of each are as follows:

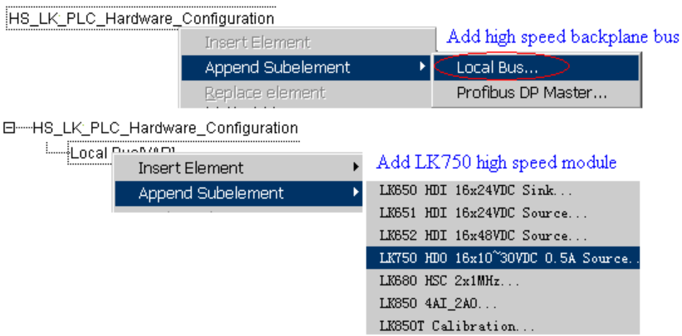


Figure 11.53: Add LK750 in PowerPro V4 Configuration Software

Communication Parameters

- Communication address is the node number of high-speed module and controller communication. A unique communication address is assigned to each high-speed module in the bus link. If there is any error of the communication address, the slave station module will not be able to establish communication with the controller.
- LK750 high-speed module is installed on the local backplane. Its unique communication address is determined by the slot number of LK750. *Refer to Chapter 2: Backplanes for the detailed assignment of communication address.*
- After high-speed modules are added in the configuration, each high-speed module will have a default “Node ID”, as shown in Figure 11.54. This address is not the correct communication address of the high-speed module (which is determined by the slot) but an address automatically assigned to the module by the software according to the adding order.
- The correct communication address of each high-speed module shall be re-assigned in parameter “Node ID”. Other parameters keep their default value and do not need modification.
- After adding or deleting high-speed module in configuration or re-locating the slot of high-speed module on the backplane, the communication address in the “Node ID” shall be checked to ensure it is still correct.

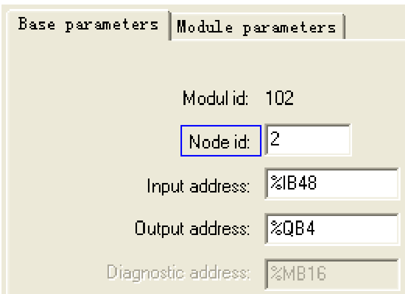


Figure 11.54: Setting of LK750 Communication Address

User Parameters

- For LK750 high-speed modules, there two ways for output
- Normal/scheduled output: For “normal output”, the output is done in real-time according to the command of the controller; whereas for the "scheduled output", the control command sent by the controller will be output after a delay.
- Inhibit/do not inhibit module: When a module is “not inhibited”, the output mode is chosen according to the “normal/scheduled output” settings; when a module is “inhibited”, the module will not communicate with the controller, will not upload diagnosis, and will not respond to the output command sent by the controller.
- Whether output is scheduled and whether the module is inhibited can be chosen using module parameters. An LK750 module can only choose one output mode.
- Module parameters are used to configure the module’s operating mode. They are written into the controller during the download of user program and will not be read in every scanning circle. Each parameter has a default value that can be changed according to requirements of the project. Module parameters do not support online modifications; therefore they can only be effective after the full download.
- As shown in Table 11.15, LK750 module parameters include whether to inhibit the module, whether the output is scheduled, whether to perform field power loss detection and output in program mode and fault mode.

Module Parameters	Parameter Definition
Inhibit Mode Enable	Whether the module is inhibited =Disable, not inhibited (default) =Enable, inhibit the module
FieldPowerLossDetection	Field Power Loss Detection =Enable, field power loss detection not enabled (default) =Disable, field power loss detection enabled
CH9to16_ScheduledOutputEnable	Channel 9~16 scheduled output Value range: 0 (default) ~255 bit 0 (corresponds to channel 9) =0, scheduled output not enabled (default) =1, scheduled output enabled Similar for bit 1 ~ bit 7
CH1to8_ScheduledOutputEnable	Channel 1~8 scheduled output Value range: 0 (default) ~255 bit 0 (corresponds to channel 1) =0, scheduled output not enabled (default) =1, scheduled output enabled Similar for bit 1 ~ bit 7
CH9to16_ProgramModeOutputEnable	Output of channels 9~16 in program mode Value range: 0 (default) ~255 bit 0 (corresponds to channel 9) =0, retain output (default) =1, output program mode state Similar for bit 1 ~ bit 7
CH1to8_ProgramModeOutputEnable	Output of channels 1~8 in program mode Value range: 0 (default) ~255 bit 0 (corresponds to channel 1) =0, retain output (default) =1, output program mode state Similar for bit 1 ~ bit 7
CH9to16_ProgramModeState	Channels 9~16 program mode state Value range: 0 (default) ~255 bit 0 (corresponds to channel 9) =0, OFF (default) =1, ON Similar for bit 1 ~ bit 7
CH1to8_ProgramModeState	Channels 1~8 program mode state Value range: 0 (default) ~255 bit 0 (corresponds to channel 1) =0, OFF (default)

	=1, ON Similar for bit 1 ~ bit 7
CH9to16_faultModeOutputEnable	Output of channels 9~16 in fault mode Value range: 0 (default) ~255 bit 0 (corresponds to channel 9) =0, retain output (default) =1, output fault mode state Similar for bit 1 ~ bit 7
CH1to8_FaultModeOutputEnable	Output of channels 1~8 in fault mode Value range: 0 (default) ~255 bit 0 (corresponds to channel 1) =0, retain output (default) =1, output fault mode state Similar for bit 1 ~ bit 7
CH9to16_FaultModeState	Channels 9~16 fault mode state Value range: 0 (default) ~255 bit 0 (corresponds to channel 9) =0, OFF (default) =1, ON Similar for bit 1 ~ bit 7
CH1to8_FaultModeState	Channels 9~16 fault mode state Value range: 0 (default) ~255 bit 0 (corresponds to channel 1) =0, OFF (default) =1, ON Similar for bit 1 ~ bit 7

Table 11.15: Definition of LK750 User Parameters

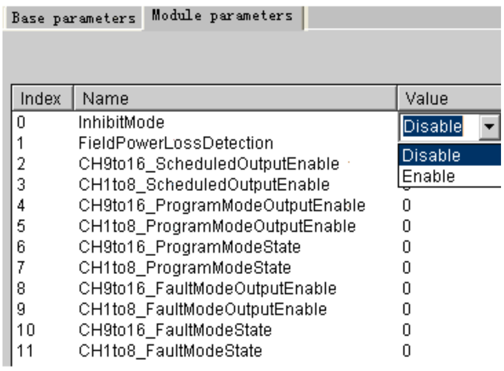


Figure 11.55: Setting of LK750 Module Parameters

Specifications of Data Area

- Input data is the data the will be uploaded from slaves during every scan period. Output data is the data that the controller distributes to slaves during every scan period. When the user program is running, such data can be modified online.
- LK750 reports the channel status readback data to the controller in every scan period while the controller sent channel output data and scheduled time to LK750.
- The readback data of output status (OutputDataBack) send the channel output status to the controller for the user programming.

Data Area		Definition
Output Data (%Q)	OutputData	Output of channel 1~16, bit0 is corresponding to channel 1, 1=close; 0=close
	scheduledTime_H	High byte of scheduled time (us)
	ScheduledTime_M	Middle byte of scheduled time
	ScheduledTime_L	low byte of scheduled time
Input Data (%I)	OutputDataBack	Channel 1~16 output status readback, bit0 to channel 1

Table 11.16: LK750 input and output data definitions

```
⊟ HS_LK_PLC_Hardware_Configuration
    ⊟ Local Bus[VAR]
        ⊟ LK750 HDO 16x10~30VDC 0.5A Source[VAR]
            AT %QW0: WORD; (* OutputData *) [CHANNEL (Q)]
            AT %QB2: BYTE; (* ScheduledTime_H *) [CHANNEL (Q)]
            AT %QB3: BYTE; (* ScheduledTime_M *) [CHANNEL (Q)]
            AT %QB4: BYTE; (* ScheduledTime_L *) [CHANNEL (Q)]
            AT %IW0: WORD; (* OutputDataBack *) [CHANNEL (I)]
```

Figure 11.56: LK750 Input/Output Data Interface

11.4.8 Module Installation and Un-installation

Refer to chapter 1 on "Module Insertion Mechanical keys" and "Module Insertion and Removable" for more details.

11.4.9 Technical Specifications

LK750 16-Channel 24VDC High-Speed Source DI Module	
System Power Supply	
operating voltage	24VDC (-15% ~ +20%)
Backplane Current	80mA max@24V DC
Output Channel	
Number of Channels	16 channels
Output Switch	MOSFET
Isolation Voltage	System to field 500VAC@1min, current leak 5mA
Output rated voltage	24VDC
Output Voltage Range	10VDC~31.2VDC
Output Rated Current Each point Each module	 0.5A@40℃&0.4A@60℃ (linear decreasing) 8A@40℃&6.4A@60℃ (linear decreasing)
Inrush Current on Each Point	1A, lasing 10ms, period 2s@60℃
Over-Current Protection	Every 2 points share a self-recover fuse
Minimum load current	3mA / point
Maximum On-state Voltage Drop	150mV@0.5A
Maximum OFF-state Current Leak	1mA / point
Output Delay Time OFF→ON ON→OFF	 1ms (maximum) 1ms (maximum)
Scheduled output	Maximum delay output time 16.7s with the resolution of 1μs
Configurable fault mode output state of each point	Hold Last State (default); ON of OFF
Configurable program mode output state of each point	Hold Last State (default); ON of OFF
Failure Diagnosis and Hot Swamp	
Field Power Loss Detection	Field power loss: device diagnosis byte 0x48; power recovered: diagnosis byte 0x40
Hot Swap	Support
Communication Bus	
Protocol	HollySys proprietary protocol
Baud Rate	32Mbps
Media	Communication bus is connected to the backplane through euro connector
Physical Features	
Mechanic Keys to Prevent Incorrect Insertion	E0
Installation	Installation slot on the local backplane.
Dimensions	Width × Height × Depth = 35mm×100mm×100mm
Casing Protection Level	IEC60529 IP20
Weight	185g
Working Environment	
Working temperature	0~0°C
Working Relative Humidity	5%~95%, no condensate
Storage Temperature	-40~70°C
Storage Temperature	5%~90%, no condensate

Table 11.17: Technical Index of LK750 Module

11.5 LK850 4-CHANNEL AI AND 2-CHANNEL AO HIGH-SPEED ANALOG MODULE

11.5.1 Features

- 4 channels of voltage or current inputs, 2 channels of voltage or current outputs
- Input signals: -10.25~+10.25V/0~10.25V/0~5.125V/4~20.58mA/0~20.58mA
- Output signals: -10.25~+10.25V/0~10.25V/0~5.125V/4~20mA/0~21mA
- AI Channel Limit Exceeded Alarm
- AI Channel Range Exceeded Alarm
- AI Channel Time Stamp
- AI Channel Limit Exceeded Interrupt
- Supports 32Mbps high-speed local bus
- System-to-Field Isolation
- AI Channel Line-Break Detection
- AI Channel Alarm Latch
- AI Channel Synchronization
- Output Channel Program Mode
- Output Channel Fault Mode
- Supports hot swap

11.5.2 Operation Principles

Input Channel: voltage signals from the field go through filter, voltage division and A/D conversion and are read by LK850 micro-processor as the acquired code value; while current signals go through I/V conversion, filter, voltage division and A/D conversion and be read by LK850 micro-processor as the acquired code value. All code values are reported to the controller through high-speed local bus.

Output Channel: the controller sends output signals to LK850 through high-speed local bus to control DAC to output proper voltage signals, then the driver circuit receive the voltage signals output by DAC and output correspondence voltage/current signals to control the field load.

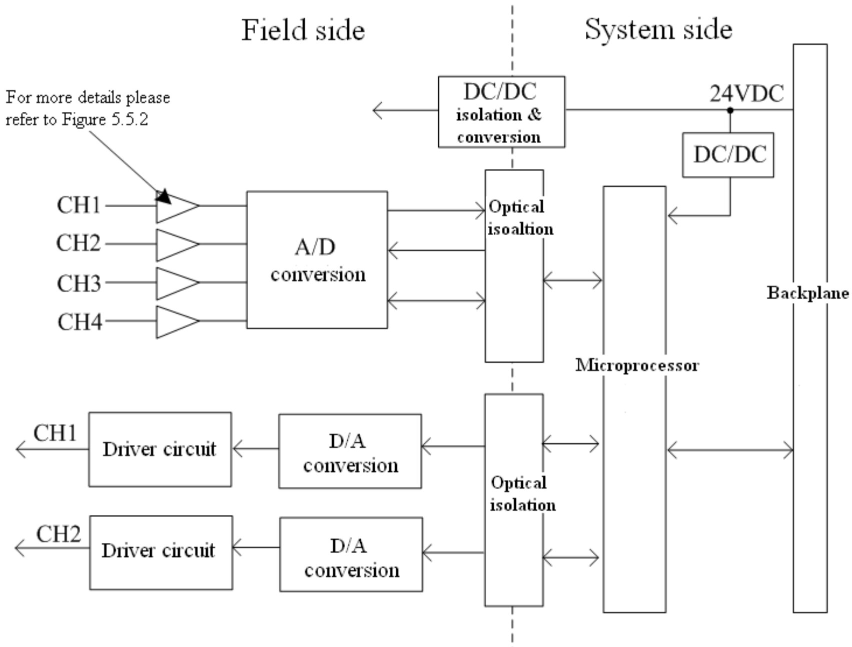


Figure 11.57: Internal Structure of LK850 Module

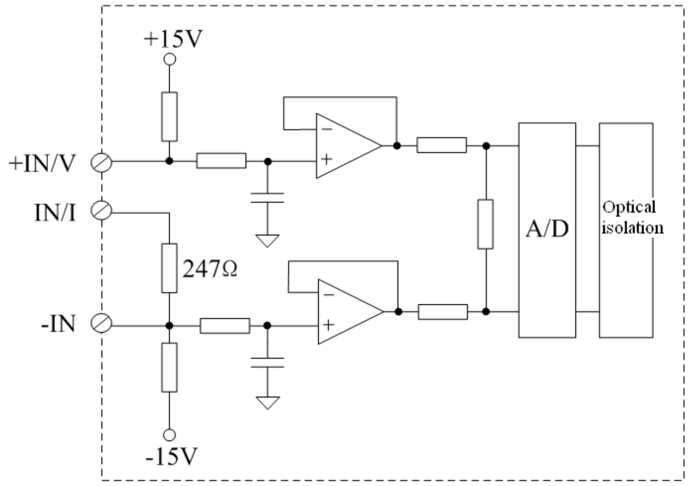


Figure 11.58: LK850 Input Channel Interface Circuit

11.5.3 Indicators Definition

There are two status indicators on LK415 front panel: the green RUN indicator and the yellow CAL indicator. RUN indicator is the operation indicator that shows the communication status between the module and the controller. CAL is the calibration indicator that shows the calibration process of the module.

LK analog modules support calibration on the field. The definitions of the indicators under operation mode differ from those under calibration mode.

Operation Mode

- After the power is on, the module waits for initialization data while the green light flashes with a frequency of 4 times per second.
- After the initialization is completed, the green light is constantly on to indicate the module in normal operation; if any error occurs in the initialization, then the communication is not established and the green light keeps flashing. Then, communication parameter settings shall be checked.
- Green light is constantly on in normal communications; green light flashes when communication breaks; green light returns to constant on when communication re-established.
- The yellow light is off in operation mode.

Operation Mode	RUN (Green)	CAL (Yellow)	Definition
	Off	Off	Power Off or Module Failure
	Flash	Off	Communication is not established or communication error
	On	Off	Normal communication

Table 11.18: Definition of LK850 Indicators in Operation Mode

Calibration Mode

- After the power is on, the module waits for initialization data while the green light flashes with a frequency of 4 times/second.
- When the initialization is completed and the module is waiting for calibration instruction to start the calibrating operation, the yellow light flashes with a frequency of 4times per second; when the calibration program starts and the module is in calibration mode, the yellow light is constantly on; when the calibration is completed, the yellow light flashes again.
- In the calibration process, the green light is constantly one. If the communication halts, the green light flashes, when the communication is re-established, the green light is constantly on again.
- If the communication is not established or halts, the yellow light will be off.

	RUN (Green)	CAL (Yellow)	Definition
Calibration Mode	Off	Off	Power Off or Module Failure
	Flash	Off	Communication is not established or communication error
	On	On	In the Calibration process
		Flash	No calibration or Calibrating process completed

Table 11.19: Definition of LK850 Indicators in Calibration Mode

11.5.4 Wiring Specifications

LK850 is a high-speed module that can be only installed on local backplanes. The LK series backplanes support two types of wrings: terminal wiring and prefabricated cable wring.

Wiring to Backplane Terminals

- Wiring of LK850 is connected through the terminals of its correspondence slot on the backplane. The relationship between channels and terminals is shown in Table 11.20. In wiring, the following shall be noted:
- Each channel of AI or AO signals of the field is connected to its respective terminal through two (shielded) cables.
- The input channels do not supply power to the transformer; therefore a separated field 24V DC power supply will be needed when the channel is connected to a two-wire transformer.
- For current signals, Terminal 01 and Terminal 03 of Channel 1 can be short connected to be the positive end of current input, Terminal 04 and Terminal 02 of Channel 2 can be short connected to be the positive end of current input, similar applications to other channels.
- Terminal 17 and Terminal 18 shall not be used in wiring.
- A single terminal shall not be connected to many wires; therefore multiple-point connection can be established through bus bar or transferring terminal board.

Channel Number	Terminal Number			
	Voltage Signal		Current Signal	
Input Channel	Positive End (+IN/V)	Negative End (-IN)	Positive End (+IN/I)	Negative End (-IN)
Channel 1	01	05	03/01 (Short connect Terminal 01 and 03, similar application to other channels.)	05
Channel 2	02	06	04/02	06
Channel 3	07	11	09/07	11
Channel 4	08	12	10/08	12
Output Channel	Positive End (VIout)	Negative End (Com)	Positive End (VIout)	Negative End (Com)
Channel 1	13	15	13	15
Channel 2	14	16	14	16

Table 11.20: Definitions of LK850 Backplane Wiring Terminals

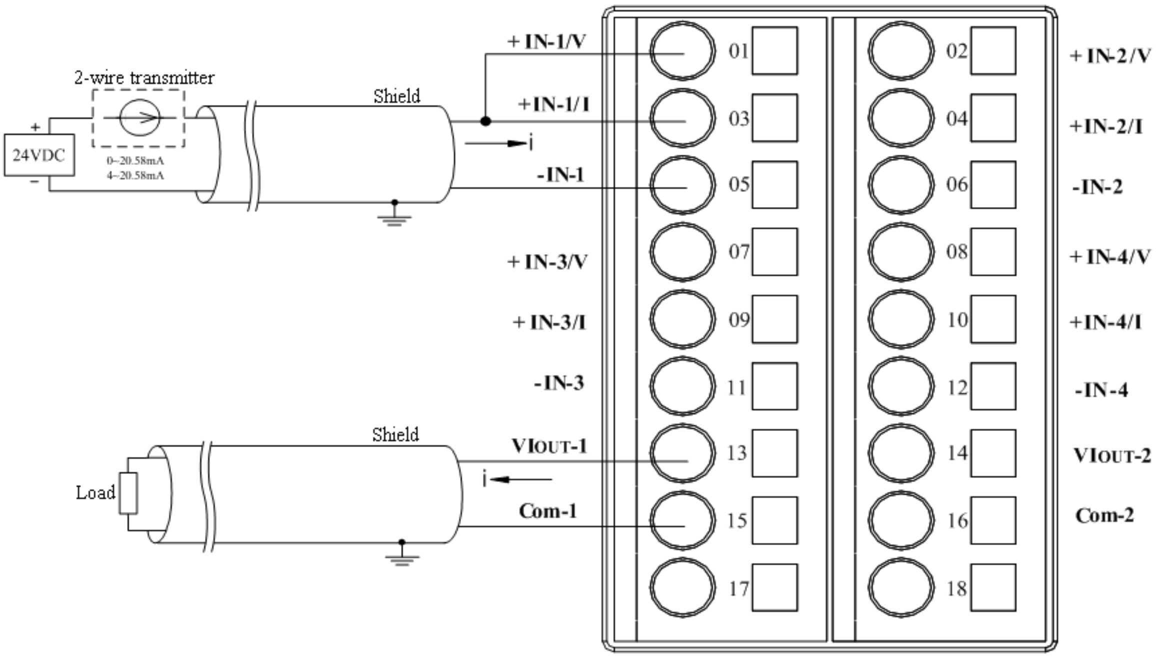


Figure 11.59: Backplane Terminal Wiring of 2-wire Current Signals

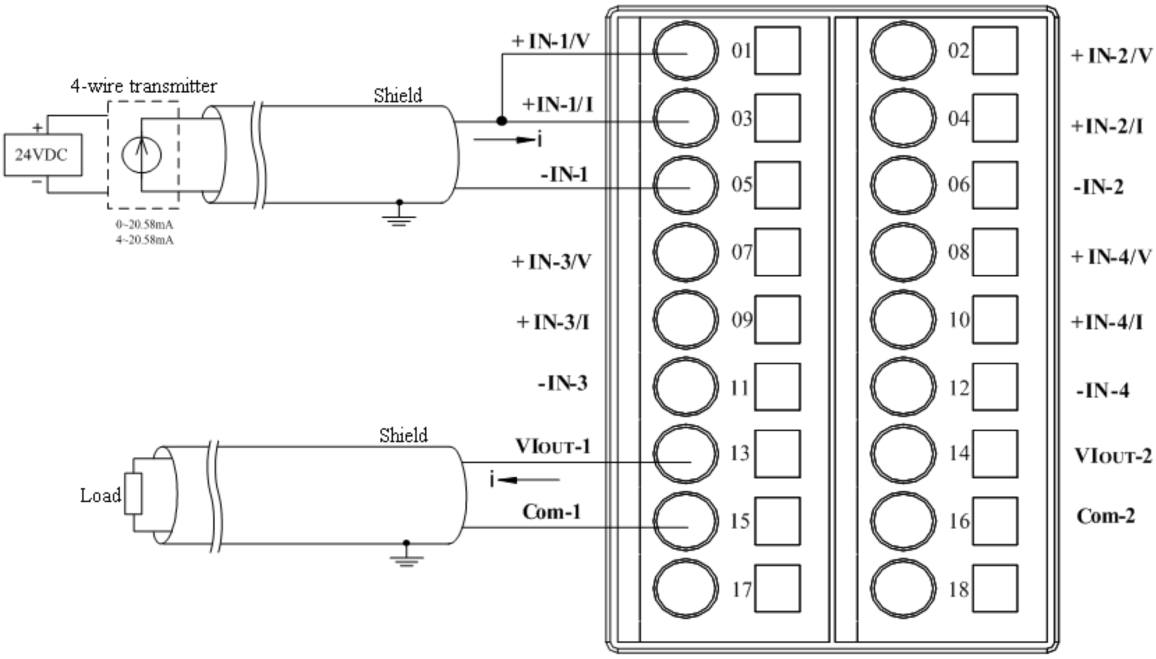


Figure 11.60: Backplane Terminal Wiring of 4-wire Current Signals

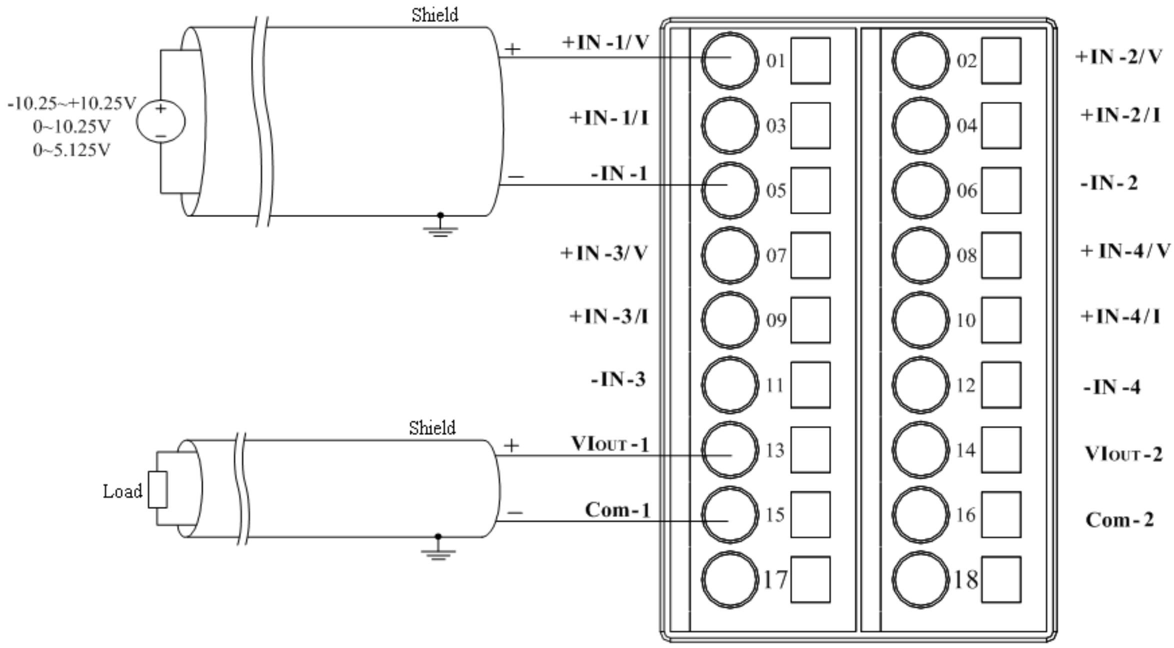


Figure 11.61: Backplane Terminal Wiring of Voltage Signals

Wiring to Terminal Modules

Please refer to the information found on Chapter 12: Terminal Module.

11.5.5 Function Specifications

LK850 is a high-speed module that provides comprehensive analog processes. Its signal channels support both high-speed AI and high-speed AO while it supports signal types of voltage and current. LK850 hardware provides functions of filter, interrupt, time stamp and alarm latch that can be directly configured by users in the hardware parameter.

Data Format Specifications

- KJ850 converts the electric signals it obtained into 2 byte positive integer cods (decimal 0~65535) outputs. Different from other I/O modules, its range of electric signals only maps in a certain segment of 0~65535.

- For the program mode, fault mode and limit exceed alarm configuration of static parameters, the electric signals shall be converted to their decimal codes, the equation is as follow (voltage unit: V, current unit: mA):
- Input channel code value conversion (to configure limit exceeded alarm value)
  - voltage range
    - Positive voltage: code value = (32767 ×input voltage ×2.6) / (22.1×2.5)
    - Negative voltage: code value = 65535 - (32767 ×|input voltage| ×2.6) / (22.1×2.5)
  - current range
    - Code value = (32767 ×input current ×247 ×2.6) / (22.1 ×2.5 ×1000)
- Output channel code value conversion (to configure program mode value and fault mode value):
  - voltage range
    - Code value = 65535 ×((input voltage ×1.8 /5) +4.096) /(2 ×4.096)
  - current range
    - Code value = 65535 ×((input current ×1.8 /10) +4.096) /(2 ×4.096)
- Similarly, the code values of dynamic parameters are also a segment in the range of 0~65535,

Range Specifications

- As shown in Table 11.21, the code value range of LK850 measurement range only occupies a segment of 0~65535. In the configuration, special range conversion function blocks shall be called to convert the engineering units (signals of field temperature, pressure, etc) and the code value. For input channels, HS_LK850_AI function block shall be called to convert code values into engineering units; while for output channels, HS_LK850_AO function block shall be called to convert engineering units into code values.

For the detailed usage of range conversion function blocks, please refer to the section of Function Block Specifications.

Channel Type	Channel Signal	Maximum Range of the Channel	Code Value of Minimum Signal	Code Value of Maximum Signal
AI	Voltage	-10.25~+10.25V	49730	15805
		0~10.25V	0	15805
		0~5.125V	0	7903
	Current	4~20.58mA	1523	7838
		0~20.58mA	0	7838
AO	Voltage	-10.25~+10.25V	3248	62287
		0~10.25V	32768	62287
		0~5.125V	32768	47527
	Current	4~20mA	38527	61567
		0~21mA	32768	63007

Table 11.21: The Relation of LK850 Channel Signals and their Machine Codes

AI Channel Limit Exceeded Interrupt

- The input signal limit exceeding can be considered as an event to trigger the controller executing the correspondence user program segment once. This is the interrupt function of LK850.
- LK850 selects whether to generate an interrupt when input signal exceeds the limit by the parameter "AI_OverLimitInterruptEnable", the default value of which is "Disable". The limit exceeded interrupts of each channel are configured separately and differently.
- After the interrupt is enabled, if the input signal exceeds limits (exceeds upper or lower limits), LK850 sends interrupt request to the controller and requires the immediate respond from the controller. The controller can quickly detect limit exceeding of an input channel of LK850 module without waiting for the reported diagnosis data in the scan period.
- On the LK local backplane, only the 4 I/O slots near the controller support the interrupt function. Therefore the LK850 module with its interrupt function enabled shall be installed on these 4 slots.

9	AI_OverLimitInterruptEnable	0
10	AI_SynchronizationSample	Disable
11	TimeStampEnable	0

Figure 11.62: LK850 Input Channel Configuration

AI Channel Time Stamp

- LK850 provides Time Stamp function to record the Coordinated System Time (CST) of the sample signal in a channel.

- Coordinated system time is the system time maintained by the controller to synchronize the high-speed I/O modules on the local backplane. CST is recorded by an 8 bytes clock timer in the unit of microsecond (μs). Since the maximum recording range is 2^{64} microseconds (more than 500 thousand years), there is no need to consider timer exceeding when the system is put into operation.
- The time stamp function means writing the current coordinated system time into the module's time stamp register when sampling input signals. Then the time stamp value and AI data are uploaded to the controller together through the high speed bus.
- In one scan period, one high-speed module can only sent one time stamp to the controller. Therefore, it is suggested to enable the time stamp function in only one channel. If the time stamp function is enabled in more than one channel at the same time, then only the time stamp value of the last sampling in one scan period will be uploaded. In case of lower requirement on time accuracy, time stamp function can enable in more than one channel.
- Whether the time stamp function is enabled can be configured by user parameter "TimeStampEnable". The default value of which is "Disable".
- Time stamp value consists of 8 BYTE type variables that it can be divided into Timestamp8~Timestamp1 according to the sequence of hexadecimal high byte to low byte, as shown in Figure 11.63.

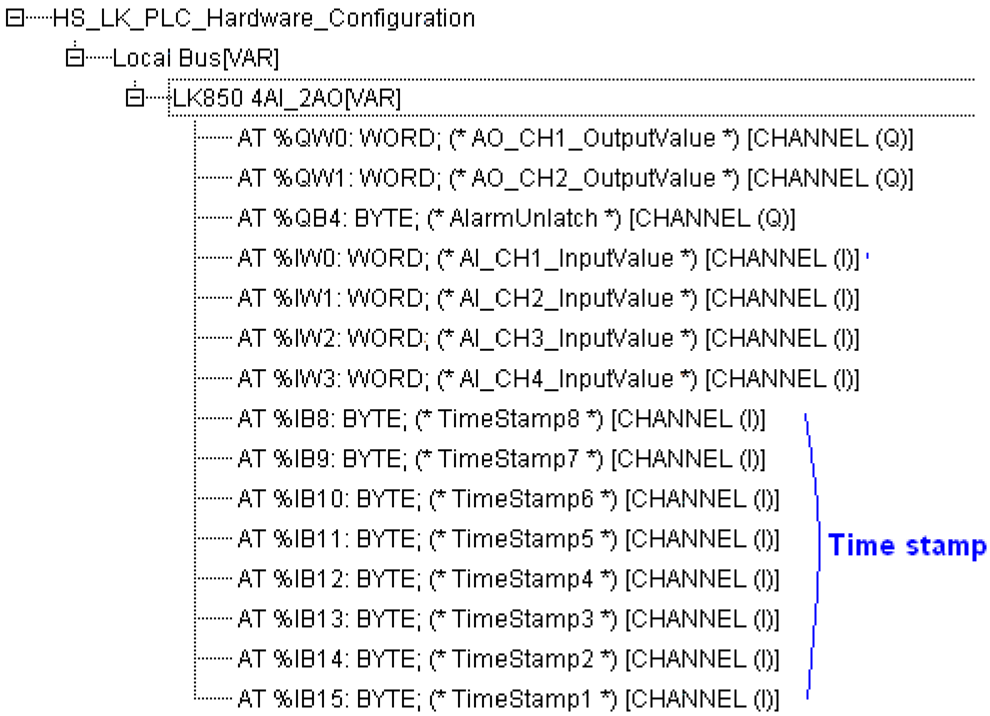


Figure 11.63: LK850 AI Channel Time Stamp

AI Channel Synchronization

- When 2 or more LK850 modules operate together and there is a strict requirement on input signal time accuracy, the input between them shall be synchronized. The input channels of LK850 modules on the same local backplane can be configured as input synchronized.
- Whether to enable the input synchronization function can be select by parameter "AI_SynchronizationSample". The default setting of which is "Disable".
- After the input synchronization is enabled, the controller sends synchronization instruction in the form of broadcast package. When two LK850 modules on the same backplane receive the broadcasted data, they carry out input data sampling at the same time point.

AI Channel Alarm Latch

- LK850 input channels provide alarm latch function. When an alarm occurs in an input channel, the latch function is activated to lock the failure value of this kind of alarm in the diagnosis byte. When failure recovered, or the same kind failure occurs again, module will not report new value.
- The latching of one alarm type does not affect the alarm reports of other alarm types. The range exceeded, limit exceeded and line-break alarm latch function of each channel can be configured separately. *Refer to the section of "Parameter Specifications" for details.*
- Whether to enable the latch function is selected by parameter, the default setting of which is "Disable".

- After the latch function is enabled, the failure value will not change any more. In order to receive new diagnosis data, the controller can send unlatch signal to clear the latch information. The unlatch instruction is sent by the dynamic parameter "AlarmUnlatch". When parameter value =0, not unlatch; when parameter value =1, unlatch.

```
⊟HS_LK_PLC_Hardware_Configuration
    ⊟Local Bus[VAR]
        ⊟LK850 4AI_2AO[VAR]
            AT %QW0: WORD; (* AO_CH1_OutputValue *) [CHANNEL (Q)]
            AT %QW1: WORD; (* AO_CH2_OutputValue *) [CHANNEL (Q)]
            AT %QB4: BYTE; (* AlarmUnlatch *) [CHANNEL (Q)]
```

Figure 11.64: LK850 Alarm Unlatch Configuration

Enable AO Channel Output

- Output enable is only for the output channels.
- When user program is operated (the switch key is turned to "RUN" or to "REM" and executes "Run" instruction in the configuration software), the channel shall output control instructions, and e.g. the output is enabled. Whether to enable output after the power on will affect the output channel status in fault mode and program mode.
- After power on, the initial position of the controller key switch determines the initial status of the system:
- Key switch locates at "RUN" position when the power is on, user program is operated and output is enabled.
- Key switch locates at "REM" position when the power is on, user program is not operated, output is not enabled and the module retains initial status with its channels output 0V.
- Key switch locates at "PRG" position when the power is on, user program is not operated, output is not enabled and the module retains initial status. In this case, even the module is in program mode, the output channels still do not output program value since the output is not enabled. To output program mode value, the key switch shall be turned back to "PRG" position after the user program is operated and the output is enabled.
- Default position of controller key switch is "REM" that after power on, module retains initial status and output is not enabled. After user program is operated and output is enabled, the output channel then shall output the data send by the controller.

AO Channel Program Mode

- Program mode is a working mode of the controller to modify, edit and download user programs. In program mode, user programs are halted and cannot be restarted through programming software. Not under control, output channel retains output (Hold Last Value) or outputs a value preset in the configuration, known s the Program Mode Value.
- Under program mode, whether the module retains output or outputs program mode value can be configured in software. Modifications of configuration will only be effective after the full download. Special notes shall be taken that: after the full down and before the operation, the module is under program mode and outputs previous program mode value. The new value will only replace the previous one after the operation of user program.
- Controller can make the slave station enter or exit program mode through the following methods:
  - Turn the key switch to "PRG" to force all output modules into program mode. Then, operation of user program halts, LK850 output channels output program mode value.
  - After the full-download of user program, output module automatically enters program mode no matter whether the controller key switch is located at "PRG". If the output module has never output any data before the download (e.g. output is not enabled), it will retain the output 0. If the module output has been enabled before the download, module outputs program mode value.

Please note that if the module has never been output enabled, it does not output program mode value even it enters the program mode.

  - Turn the key switch to "RUN", slave station exits program mode and controller runs the user program, the output is enabled.
- Program mode output is configured by user parameter "Program Mode Output", default value of which is "Hold Last Value". Program mode value is configured by user parameter "Program Mode value", default output is 0V. Parameters of each channel are configured separately without interfering others.

30	AO_ProgramModeOutput	0
31	AO_FaultModeOutput	0
32	AO_CH1_ProgramModeValue	0
33	AO_CH2_ProgramModeValue	0

Figure 11.65:LK850 Output Setting under Program Mode

- Special notes shall be taken that the parameter value is not the actual electric signal but the converted code value. Therefore the default value 0 does not indicate "no output". *Refer to the section of "Data Format Specifications" for the*

detailed conversion between the two. Take channel 1 voltage output for example, to configure the channel output 0V voltage in program mode, the parameter "AO_CH1_ProgramModeValue" shall be first set as 1 to indicate that the program mode output of channel 1 is "Output Program Mode Value". Then, according to the output channel voltage range conversion equation, the code value of 0V voltage = 65535 ((voltage value ×1.8 /5) +4.096) /(2 ×4.096) = 32768. The parameter "AO_CH1_ProgramModeValue" shall be configured as 32768 to indicate the program mode value of channel 1 is 0V.

Communication Failure

- When communication failure occurs, the communication between controller and output module is broken and the "RUN" light flashes. The module may be in one of the following states in communication failure:
- After power on, module cannot establish communication with the controller, and then the module will retain the initial status that its output is not enabled and the output channel outputs 0.
- Module in operation when communication failure (offline) occurs: module retains output or outputs a value preset in the configuration, known as the Fault Mod Value. Whether the module retains output or outputs fault mode state can be configured in software.
- Module in program mode when communication failure occurs: module enters fault mode and outputs fault mode value. When failure recovered, module returns to program mode automatically and outputs program mode value again.
- If the module output has not been enabled, the module does not output fault mode value even if any communication failure occurs.
- Fault mode Output of output channel is configured by user parameter "AO_FaultModeOutput", default value of which is "Hold Last Value". Fault mode value is configured by user parameter "AO_CH1_FaultModeValue ~ AO_CH2_FaultModeValue", default output of which is 0. Special notes shall be taken that the parameter value is not the actual electric signal but the converted code value. Therefore the default value 0 does not indicate "no output". For example, when the output channel is set to voltage range, the parameter value of output 0V is 32768. In the configuration, user may choose proper fault mode voltage according to field conditions and convert it into code values. *Refer to the section of "Data Format Specifications" for the detailed conversion between the two.*

31	AO_FaultModeOutput	0
32	AO_CH1_ProgramModeValue	0
33	AO_CH2_ProgramModeValue	0
34	AO_CH1_FaultModeValue	0
35	AO_CH2_FaultModeValue	0

Figure 11.66: Setting of LK850 Fault Mode Value

Output Response Time of AO Channels

- Indicating the output channel responding speed to the output instructions, the output response time is the interval between the LK850 receiving data sent by the controller in the scan period and the outputting of data. The output responding time of the 2 output channels can be set shorter than 3ms or shorter than 15ms by the parameter "AO_ResponseTime".
- The output response time affects the output precision that the shorter the response time, the lower the precision and the longer the response time the higher the precision. *Refer to the section "Technical Specification" for more details.*

36	AO_ResponseTime	<3ms	<3ms <15ms

Figure 11.67: Setting of LK850 Output Response Time

Module Inhibition

- Module inhibition function forces slave station module get off the control of user program so that the module will be considered as not existed by the controller. An inhibited LK850 module receives the initialization data sent by the controller, but does not communicate with the controller, report diagnosis information or upload data.
- The inhibition function is only effective after a full download. After the full download, the module enters program mode automatically. If the LK850 module has never output any data before the download (e.g. output is not enabled), it will retain the initial output status 0.Otherwise, it outputs the program mode value. The input area is cleared after the full download, so the input value is always 0.
- When the module is inhibited, its "RUN" light flashes.
- Whether to inhibit the module is selected by user parameter "Inhibit Mode", the default value of which is "Disable".

0	InhibitMode	Disable

Figure 11.68: Module Inhibition Setting of LK850

11.5.6 Diagnosis Specifications

In PowerPro V4 configuration software, the diagnosis functions are fulfilled by calling the expansion diagnosis library. For the high-speed modules, the high-speed bus diagnosis function block HS_LocalBusSlaveDiag in the diagnosis library HS_Diagnosis.lib shall be called to diagnosis the high-speed module on a local backplane slot (NodeID), as shown in Figure 11.69.

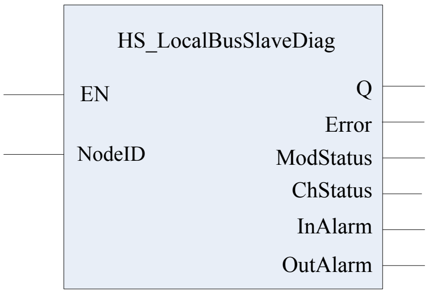


Figure 11.69: High-Speed Bus Diagnosis Function Block of PowerPro V4

The diagnosis library can provide diagnosis information about the operation status of the module internals, its channels, field power supply and module parameters, information about module types and whether there are errors in the channel. For detailed usage of High-Speed Diagnosis Function Block, please refer to LK Large Scale PLC Instruction Manual.

Users shall note that the Diagnosis library is an external library that shall be first installed in the Library Manager before use.

The diagnosis information of high-speed module includes: device diagnosis and channel diagnosis. All diagnosis data exist in the form of block structure.

- Device Diagnosis: records of whether the module has diagnosis information.
- Channel Diagnosis: records of the channel level diagnosis information, such as line-break and rang exceeding.

Range exceeded, limit exceeded and line-break diagnosis can be applied to the LK850 input channels while over-load detection can be applied to its output channels. All these diagnoses are channel diagnosis. The definition of input channel diagnosis byte is shown in Figure 11.70 while the definition of output channel diagnosis byte is shown in Figure 11.71.

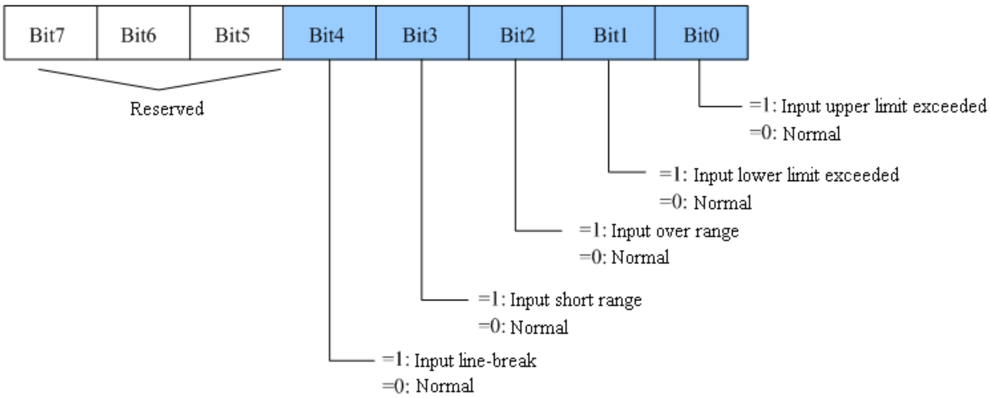


Figure 11.70: Definition of LK850 Input Channel Diagnosis Byte

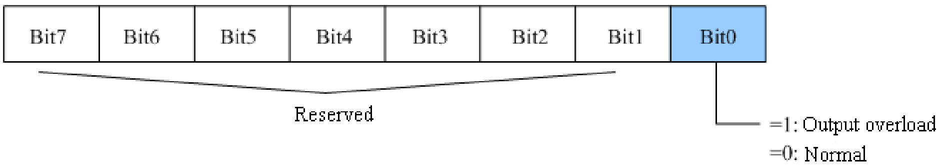


Figure 11.71: Definition of LK850 Output Channel Diagnosis Byte

After the high-speed diagnosis function block (HS_LocalBusSlaveDiag) is called, the channel diagnosis data are written into the channel output items of the function block output parameter "InAlarm" and "OutAlarm", as shown in Table 11.22.

Diagnosis Information			Definitions
Channel Diagnosis	InAlarm	InAlarm[0]	Diagnosis data of input channel 1~4, 1 byte: =0, normal Bit0=1, input upper limit exceeded alarm Bit1=1, input lower limit exceeded alarm Bit2=1, input over range alarm Bit3=1, input short range alarm
		InAlarm[1]	
		InAlarm[2]	
		InAlarm[3]	
	OutAlarm	OutAlarm[0]	Diagnosis data of output channel 1~2, 1 byte: =0, normal Bit0=1, output overload
		OutAlarm[1]	

Table 11.22: Definition of LK850 Diagnosis Information

AI Channel Range Exceeded Alarm

- LK850 input channels provide range exceeded alarm function. When the input signals exceed the preset measurement range, Channel Diagnosis reports "Over Range", when the signal fell back into range again, it will report "Failure Recovered".
- LK850 only report the diagnosis data once in a scan period.
- Whether to enable the input channel range exceeded alarm is set by module parameter "AI_OverRangeAlarmEnable" with the default value of "disable". This parameter contains 1 byte, where Bit0~Bit3 represent Input Channel 1~4.
- The range exceeded alarm of each channel is configured separately.

12	AI_OverRangeAlarmEnable	0
13	AI_OverRangeAlarmLatch	0

Figure 11.72: LK850 Range Exceeded Alarm Parameter

Maximum Measurement Range	Measurement Range	Measurement Range Exceeding	
		Over Range	Short of Range
0~20.58mA	0~20mA	＞20mA	＜0mA
4~20.58mA	4~20mA	＞20mA	＜4mA
-10.25V~10.25V	-10V~10V	＞10V	＜-10V
0~10.25V	0~10V	＞10V	＜0V
0~5.125V	0~5V	＞5V	＜0V

Table 11.23: Definition of LK850 Rang Exceeded Alarm Range

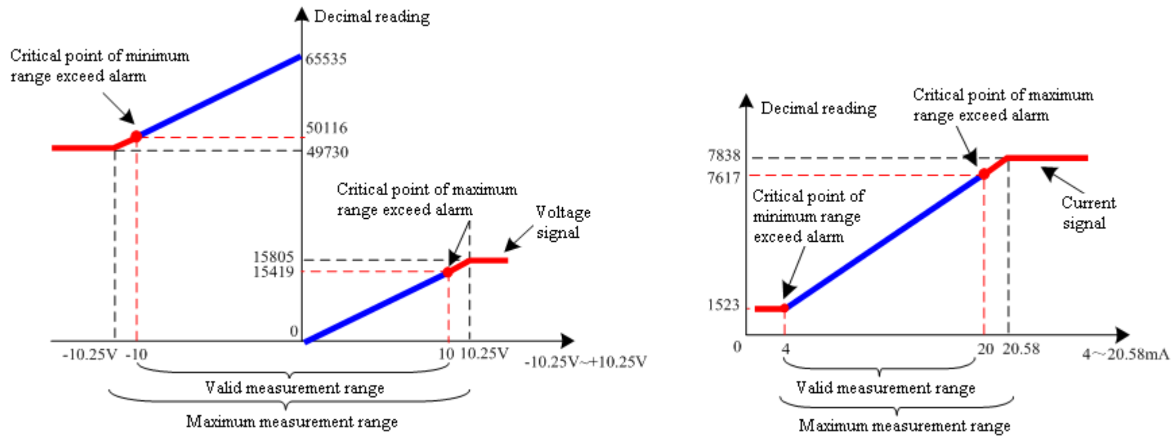


Figure 11.73: Range Exceeded Alarm Diagnosis of LK850

- In case the input signals of one channel exceed range:
  - Channel diagnosis byte report failure value according to different range exceeding types, as shown in Table 11.24.
- When signals fall back into the normal range, the channel diagnosis byte reports 0x00.

Maximum Measurement Range	Valid Range	Range Exceeding	Process of Range Exceeding
0~20.58mA	0~20mA	Over Range	The channel diagnosis byte reports failure value 0x04 20~20.58mA, the channel reports the code value 7617~7838 of the currently

			measured signal. ＞20.58mA, channel reports 7838
		Short of Range	The channel diagnosis byte reports short of range value 0x08 Channel reports 0 as measurement data
4~20.58mA	4~20mA	Over Range	The channel diagnosis byte reports failure value 0x04 20~20.58mA, the channel reports the code value 7617~7838 of the currently measured signal. ＞20.58mA, channel reports 7838
		Short of Range	The channel diagnosis byte reports short of range value 0x08 Channel reports 1523 as measurement data
-10.25V~10.25V	-10V~10V	Over Range	The channel diagnosis byte reports failure value 0x04 10~10.25V, the channel reports the code value 15419~15805 of the currently measured signal. ＞10.25V, channel reports 15805
		Short of Range	The channel diagnosis byte reports short of range value 0x08 -10.25V~-10V, the channel reports the code value 49730~50116 of the currently measured signal. ＜-10.25V, channel reports 49730
0~10.25V	0~10V	Over Range	The channel diagnosis byte reports failure value 0x04 10~10.25V, the channel reports the code value 15419~15805 of the currently measured signal. ＞10.25V, channel reports 15805
		Short of Range	The channel diagnosis byte reports short of range value 0x08 Channel reports 0 as measurement data
0~5.125V	0~5V	Over Range	The channel diagnosis byte reports failure value 0x04 5~4.125V, the channel reports the code value 7709~7903 of the currently measured signal. ＞5.125V, channel reports 7903
		Short of Range	The channel diagnosis byte reports short of range value 0x08 Channel reports 0 as measurement data

Table 11.24: LK850 Processes of Rang Exceeded Alarm for Different Ranges

AI Channel Limit Exceeded Alarm

- LK850 input channels provide limit exceeded alarm function. When input signals exceed the configured range, e.g. when they are higher than the upper alarm limit or lower than the lower limit, the channel will report diagnosis byte "exceeded limits". When input signals fall back into the configured range, the channel will report "failure recovered".
- LK850 only report the diagnosis data once in a scan period.
- Whether to enable the limit exceeded alarm function is set by the parameter "AI-LimitExceededAlarmEnable" with the default value of "disable". This parameter contains 1 byte, where Bit0~Bit3 represent Input Channel 1~4.
- After the alarm is enabled, the alarm lower limits of the 4 input channels are set separately by parameter "AI_CH1_Lower Limit Value ~ AI_CH4_Lower Limit Value" while their upper limits are set separately by parameter "AI_CH1_Upper Limit Value ~ AI_CH4_Upper Limit Value".

14	AI_LimitExceededAlarmEnable	0
15	AI_LimitExceededAlarmLatch	0
16	AI_CH1_UpperLimitValue	32767
17	AI_CH1_LowerLimitValue	0
18	AI_CH2_UpperLimitValue	32767
19	AI_CH2_LowerLimitValue	0
20	AI_CH3_UpperLimitValue	32767
21	AI_CH3_LowerLimitValue	0
22	AI_CH4_UpperLimitValue	32767
23	AI_CH4_LowerLimitValue	0

Figure 11.74: Limit Exceeded Alarm Parameters of LK850

- Figure 11.74, represented by two bytes of positive integer codes (decimal 0~65535), The alarm value in the configuration is the machine code value of those measured signal within the set Measurement Range. The value range of the upper alarm limit is 0~65535 and the default value is 32767. The value range of the lower alarm limit is

0~65534 and the default value is 0. The conversion between code value and electric signals is shown in Table 11.25. The alarm upper limit voltage (or current) shall be higher than the alarm lower limit voltage (or current), otherwise LK850 cannot correctly report diagnosis information.

Measurement Range		Setting of Alarm Value
Voltage	Positive voltage	Alarm Value = (32767 ×voltage value ×2.6) /(22.1 ×2.5)
	Negative voltage	Alarm Value = 65535 - (32767 ×|voltage value| ×2.6) /(22.1 ×2.5)
Current		Alarm Value = (32767 ×current value ×2.6) /(22.1 ×2.5)

Table 11.25: LK850 Limit Exceeded Alarm Value Conversion

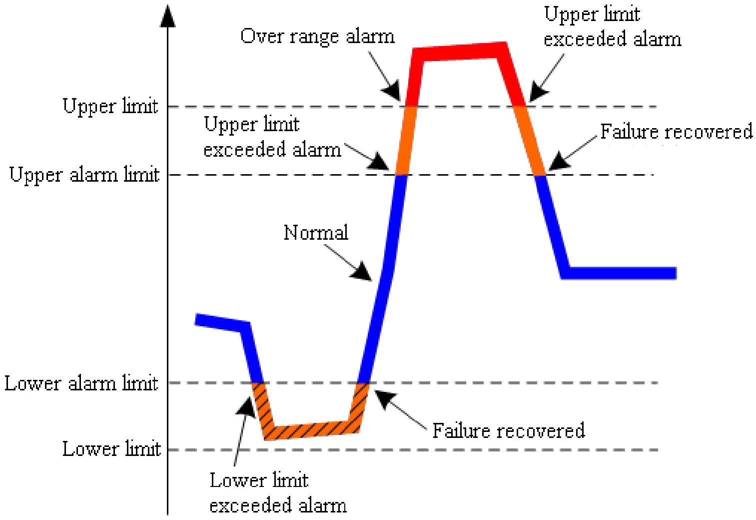
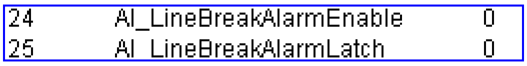


Figure 11.75: Limit Exceeded Alarm Diagnosis of LK850

- When channel input signals exceed limits:
  - Exceeded upper limit, channel diagnosis byte reports upper limit exceeded failure value 0x01
  - Exceeded lower limit, channel diagnosis byte reports lower limit exceeded failure value 0x02
- When signals fall back into the normal range, the channel diagnosis byte reports 0x00.
- The channel reports the code value of the currently measured signal.

AI Channel Line-Break Detection

- A pull-up resistor is connected to the signal input end of LK850 module to detect line-break failures in the channels.
- When there is line-break in an input channel, the positive-end voltage of the channel will be pulled up to +15V and the negative-end voltage will be pulled down to -15V, then the channel diagnosis byte reports “Line-Break”. When the connection is recovered, the channel diagnosis reports “Failure Recovered”
- LK850 module will only report the diagnosis data once respectively when line-break occurs and when the failure is recovered. The line-break alarm can be enabled through configuration software. By default, it is set as disabled.



24	AI_LineBreakAlarmEnable	0
25	AI_LineBreakAlarmLatch	0

Figure 11.76: LK850 Line-Break Alarm Parameter

Signal Type	Line-Break Types	Processes of Line-Break Alarm
Current Signal	Short connected cable (+IN/V) line-break	The channel diagnosis byte reports failure value 0x04 CChannel reports 32767 as measurement data
	Field signal cable (+IN/I, -IN) line-break	Channel reports diagnosis byte of line-break value 0x10 CChannel reports 0 as measurement data
Voltage Signal	Field signal cable (+IN/V, -IN) line-break	Channel reports diagnosis byte of line-break value 0x10 CChannel reports 32767 as measurement data

Table 11.26: LK850 Processes of Line-Break for Different Signal Types

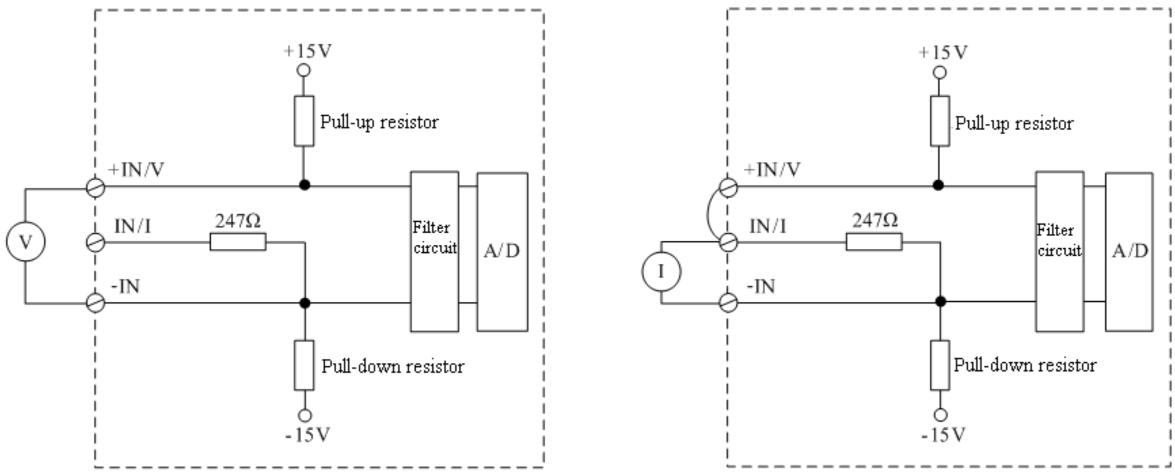


Figure 11.77: Line-Break Detection Circuit of LK850 Input Channels

AO Channel Over-Load Detection

- Output channels of LK850 provide over-load detection function. When over-load occurs in an output channel, the channel diagnosis byte reports over-load failure value 0x10. When the load fall back into normal range, channel diagnosis byte reports 0x00.
- The alarm of over-load can be enabled through configuration software, the default setting of which is “disabled”.

AO_OverloadAlarmEnable	0
AO_OverloadAlarmLatch	0

Figure 11.78: Setting of LK850 Over-Load Alarm Parameter

Output Voltage Short-Circuit Detection

- For output voltage signals, the driverable resistance load >2000Ω.
- In case when field load resistance value is too small and makes the current too large in the output circuit, the current-limit protection output Imax<25mA.
- When filed load is short-circuit (load=0), channel will be diagnosed as over-load.

Output Current Circuit-Break Detection

For output current signals, the driverable resistance load range is 0~600Ω.

- When field load resistance value is too large and the voltage on the 2 ends of the load exceeds the output capacity, the channel will be diagnosed as over-load while the output current signal does not meet the precision requirement to drive the field devices normally.
- When filed load is short-circuit (load=∞), channel will be diagnosed as over-load.

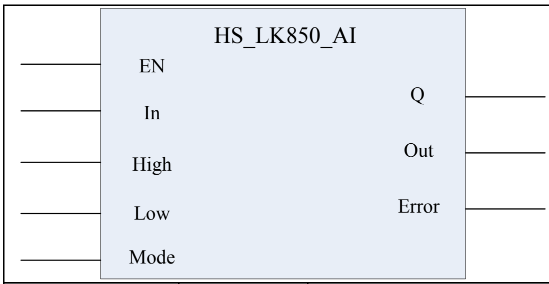
11.5.7 Function Specifications

Internal library HS_LK850_Convert.lib is employed to achieve the range conversion function of LK850 analog inputs and analog outputs. The internal library HS_LK850_Convert.lib contains the following 2 function blocks:

- HS_LK850_AI: input channel range conversion function block that mapping the code value (0~65535) reported by AI channel into the engineering unit value in the corresponding range.
- HS_LK850_AO: output channel range conversion function blocks that mapping the engineering unit value of AO channel into the corresponding code value of the range.

Input Channel Range Conversion Function Block HS_LK850_AI

- As shown in Table 11.27, this function block provides the conversion between the code value and engineering unit in the set range of AI channel. When enable EN is rest, it outputs the engineering value (Out) converted according to the selected mode (Mode) and input code value (In).
- Output the input code value after it is mapped into the engineering value in the range Low~High. When conversion completed, mark Q is set as 1 and Error set as 1 if there is any error.

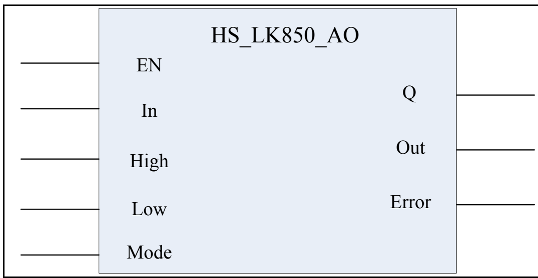


Input Parameter	Data Type	Functions Description	Parameter Specifications	Default Value
EN	BOOL	Enables input	EN=FALSE, conversion stops, Q=FALSE. EN=TRUE, conversion starts, Q=TRUE	FALSE
In	WORD	Input code value	0～65535	0
High	REAL	Range upper limit	Range upper limit of engineer value, initial value is 0	0
Low	REAL	Range lower limit	Range lower limit of engineer value, initial value is 0	0
Mode	BYTE	Mode selection	Select signal types of LK850 input channels: 0: input current signal 4~20.58mA 1: input current signal 0~20.58mA 2: input voltage signal 0~+5.125V 3: input voltage signal 0~+10.25V 4: input voltage signal -10.25~+10.25V	4
Output Parameter	Data Type	Functions Description	Parameter Specifications	Default Value
Q	BOOL	Enables output	EN=FALSE, covert ion stops, Q=FALSE. EN=TRUE, conversion starts, Q=TRUE	FALSE
Out	REAL	Output engineering value	Engineering value under different ranges	0
Error	BYTE	Error types	0: no error in current mode range conversion 1: range lower limit is higher than the upper limit 2: mode input error 3: Input code value exceeds current mode range	0

Table 11.27: LK850 Input Channel Code Value Conversion Function Block

Output Channel Range Conversion Function Block HS_LK850_AO

- As shown in Table 11.28, this function block provides the conversion between the engineering unit and the code value in the set range of AO channel. When enable EN is rest, it outputs the code value (Out) converted according to the selected mode (Mode) and input engineering value (In).
- Output the input engineering value after it is mapped into the code value in the range Low~High. When conversion completed, mark Q is set as 1 and Error set as 0 if there is no error. When conversion completed, mark Q is set as 1 and Error set as 1 if there are errors.



Input Parameter	Data Type	Functions Description	Parameter Specifications	Default Value
EN	BOOL	Enables input	EN=FALSE, covert ion stops, Q=FALSE. EN=TRUE, conversion starts, Q=TRUE	FALSE
In	REAL	Output engineering value	Engineering value under different ranges	0
High	REAL	Range upper limit	Range upper limit of engineer value, initial value is 0	0
Low	REAL	Range lower limit	Range lower limit of engineer value, initial value is 0	0
Mode	BYTE	Mode selection	Select signal types of LK850 output channels: 0: input current signal 4~20.58mA 1: input current signal 0~20.58mA	4

			2: input voltage signal 0~+5.125V 3: input voltage signal 0~+10.25V 4: input voltage signal -10.25~+10.25V	
Output Parameter	Data Type	Functions Description	Parameter Specifications	Default Value
Q	BOOL	Enables output	EN=FALSE, covert ion stops, Q=FALSE. EN=TRUE, conversion starts, Q=TRUE	FALSE
Out	WORD	Output code value	0～65535	0
Error	BYTE	Error types	0: no error in current mode range conversion 1: range lower limit is higher than the upper limit 2: mode input error 3: Input engineering value exceeds range	0

Table 11.28: LK850 Output Channel Code Value Conversion Function Block

For more details, refer to LK Series PLC - Instruction Manual.

11.5.8 Parameter Specifications

Communication Parameters

- LK850 module communicates and exchanges data with the controller through high-speed local backplane bus with a communication bandwidth of 32Mbps. Controller read input information from and sent output information to the slave station in cycles. The communication establishment between the controller and LK850 consists of three steps: parameter initialization, configuration and data exchange.
- LK850 high-speed module is installed on the local backplane. The station address is determined only by the installation slot number of LK850. *Refer to Chapter 2: Backplanes for more details.* In the configuration software, the correct station address of the module shall be filled in "Node id" of "Basic parameter". Other parameters shall keep their default values and need no modifications.

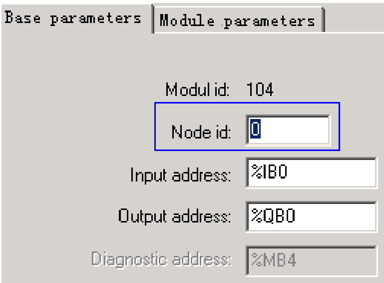


Figure 11.79: Setting of LK850 Communication Address

Dynamic Parameters

- Dynamic parameters are the data that the controller exchanges with the I/O module in every scan period. Updated once in a scan period, dynamic parameters include input data and output data. Input data are reported to the controller by LK850 while the output data are sent by controller to LK850.

Parameter Type	Parameter Name	Parameter Definition
Output Data	AO_CH1_OutputValue	Output data of Output Channel 1, 0~65535
	AO_CH2_OutputValue	Output data of Output Channel 2, 0~65535
	AlarmUnlatch	=0, no unlatch of alarm latch =1, unlatch the alarm latch
Input Data	AI_CH1_InputValue	sample data of Input Channel 1, 0~65535
	AI_CH2_InputValue	Sample data of Input Channel 2, 0~65535
	AI_CH3_InputValue	Sample data of Input Channel 3, 0~65535
	AI_CH4_InputValue	Sample data of Input Channel 4, 0~65535
	TimeStamp8~TimeStamp1	Time stamp, 8 bytes, TimeStamp8 is the highest byte of the time stamp

Table 11.29: List of LK850 Dynamic Parameters

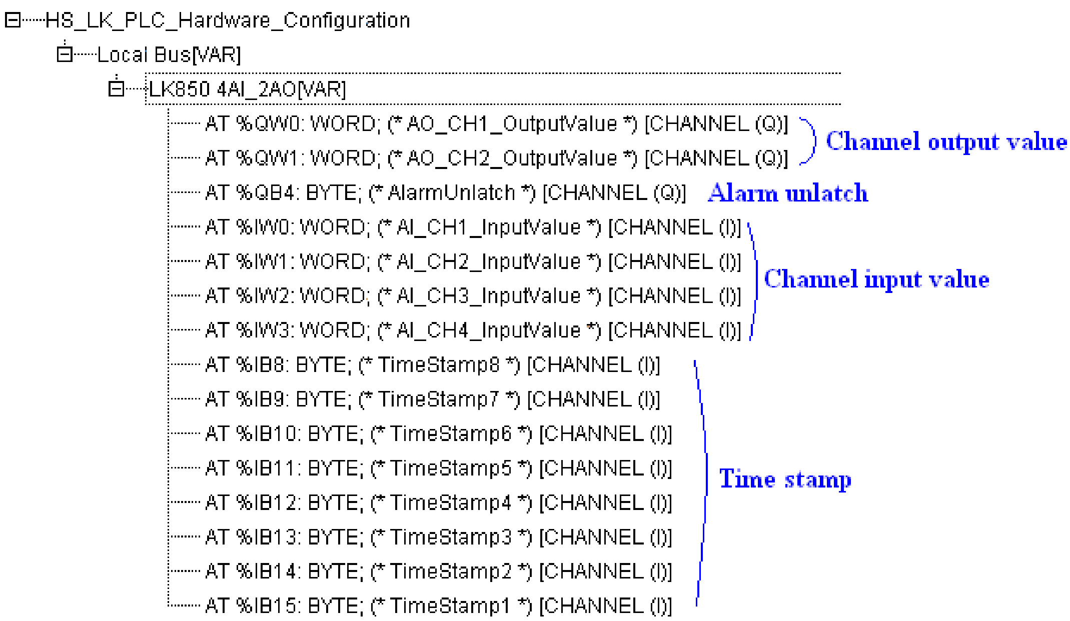


Figure 11.80: Configuration of LK850 Dynamic Parameters

Static Parameters

➢ Static parameters are used to configure the module's operating mode. They are written into the controller during the download of user program and will not be read in every scanning circle. Each parameter has a default value that can be changed according to requirements of the project. Modifications of parameter values can only be effective after the full download.

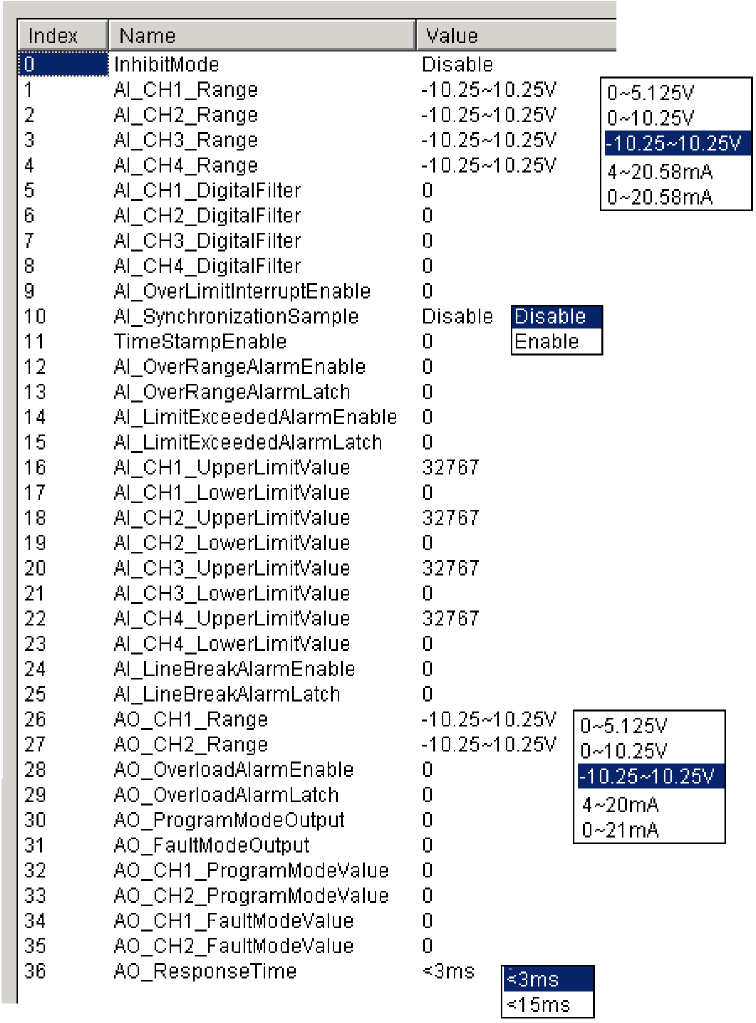
Parameter Name	Parameter Definition	Value Range
Inhibit Mode	Whether the module is inhibited	Disable, not inhibited (default) Enable: Inhibited the module
AI_CH1_Range	Range Selection of Input Channel 1	-10.25~+10.25V; 0~10.25V; 0~5.125V; 0~20.58mA; 4~20.58mA
AI_CH2_Range	Range Selection of Input Channel 2	
AI_CH3_Range	Range Selection of Input Channel 3	
AI_CH4_Range	Range Selection of Input Channel 4	
AI_CH1_DigitalFilter	Digital filter time of input channel 1	0ms (default, no filter) ~ 250ms
AI_CH2_DigitalFilter	Digital filter time of input channel 2	
AI_CH3_DigitalFilter	Digital filter time of input channel 3	
AI_CH4_DigitalFilter	Digital filter time of input channel 4	
AI_OverLimitInterruptEnable	Bit0 =0, hardware limit exceeded interrupt disabled input in channel 1 (default) =1, hardware limit exceeded interrupt enabled in input channel 1 Bit1 =0, hardware limit exceeded interrupt disabled in input channel 2 (default) =1, hardware limit exceeded interrupt enabled in input channel 2 Bit2 =0, hardware limit exceeded interrupt disabled in input channel 3 (default) =1, hardware limit exceeded interrupt enabled in input channel 3 Bit3 =0, hardware limit exceeded interrupt disabled in input channel 4 (default) =1, hardware limit exceeded interrupt enabled in input channel 4	0 (Default) ~255

	Bit4~7 reserved	
AI_SynchronizationSample	Whether the input channel synchronization is enabled	0: Disable, synchronization is disabled (default); Enable: synchronization is enabled
TimeStampEnable	Bit0 =0, input time stamp disabled in input channel 1 (default) =1, input time stamp enabled in input channel 1 Bit1 =0, input time stamp disabled in input channel 2 (default) =1, input time stamp enabled in input channel 2 Bit2 =0, input time stamp disabled in input channel 3 (default) =1, input time stamp enabled in input channel 3 Bit3 =0, input time stamp disabled in input channel 4 (default) =1, input time stamp enabled in input channel 4 Bit4~7 reserved	0 (Default) ~255
AI_OverRangeAlarmEnable	Bit0 =0, range exceeded alarm disabled in input channel 1 (default) =1, range exceeded alarm enabled in input channel 1 Bit1 =0, range exceeded alarm disabled in input channel 2 (default) =1, range exceeded alarm enabled in input channel 2 Bit2 =0, range exceeded alarm disabled in input channel 3 (default) =1, range exceeded alarm enabled in input channel 3 Bit3 =0, range exceeded alarm disabled in input channel 4 (default) =1, range exceeded alarm enabled in input channel 4 Bit4~7 reserved	0 (Default) ~255
AI_OverRangeAlarmLatch	Bit0 =0, range exceeded alarm latch disabled in input channel 1 (default) =1, range exceeded alarm latch enabled in input channel 1 Bit1 =0, range exceeded alarm latch disabled in input channel 2 (default) =1, range exceeded alarm latch enabled in input channel 2 Bit2 =0, range exceeded alarm latch disabled in input channel 3 (default) =1, range exceeded alarm latch enabled in input channel 3 Bit3 =0, range exceeded alarm latch disabled in input channel 4 (default) =1, range exceeded alarm latch enabled in input channel 4 Bit4~7 reserved	0 (Default) ~255
AI_LimitExceededAlarmEnable	Bit0 =0, limit exceeded alarm disabled in input channel 1 (default) =1, limit exceeded alarm enabled in input channel 1 Bit1 =0, limit exceeded alarm disabled in input channel 2 (default) =1, limit exceeded alarm enabled in input channel 2 Bit2 =0, limit exceeded alarm disabled in input channel 3 (default) =1, limit exceeded alarm enabled in input channel 3 Bit3 =0, limit exceeded alarm disabled in input channel 4 (default) =1, limit exceeded alarm enabled in input channel 4 Bit4~7 reserved	0 (Default) ~255

AI_CH1_UpperLimitValue	Setting of Alarm Upper Limit Value of Input Channel 1	0~65535 Alarm Upper Limit Default value: 32767 Alarm Lower Limit Default value : 0
AI_CH1_LowerLimitValue	Setting the Alarm Lower Limit Value of Input Channel 1	
AI_CH2_UpperLimitValue	Setting of Alarm Upper Limit Value of Input Channel 2	
AI_CH2_LowerLimitValue	Setting the Alarm Lower Limit Value of Input Channel 2	
AI_CH3_UpperLimitValue	Setting of Alarm Upper Limit Value of Input Channel 3	
AI_CH3_LowerLimitValue	Setting the Alarm Lower Limit Value of Input Channel 3	
AI_CH4_UpperLimitValue	Setting of Alarm Upper Limit Value of Input Channel 4	
AI_CH4_LowerLimitValue	Setting the Alarm Lower Limit Value of Input Channel 4	
AI_LineBreakAlarmEnable	Bit0 =0, line-break alarm disabled in input channel 1 (default) =1, line-break alarm enabled in input channel 1 Bit1 =0, line-break alarm disabled in input channel 2 (default) =1, line-break alarm enabled in input channel 2 Bit2 =0, line-break alarm disabled in input channel 3 (default) =1, line-break alarm enabled in input channel 3 Bit3 =0, line-break alarm disabled in input channel 4 (default) =1, line-break alarm enabled in input channel 4 Bit4~7 reserved	0 (Default) ~255
AI_LineBreakAlarmLatch	Bit0 =0, line-break alarm latch disabled in input channel 1 (default) =1, line-break alarm latch enabled in input channel 1 Bit1 =0, line-break alarm latch disabled in input channel 2 (default) =1, line-break alarm latch enabled in input channel 2 Bit2 =0, line-break alarm latch disabled in input channel 3 (default) =1, line-break alarm latch enabled in input channel 3 Bit3 =0, line-break alarm latch disabled in input channel 4 (default) =1, line-break alarm latch enabled in input channel 4 Bit4~7 reserved	0 (Default) ~255
AO_CH1_Range	Range selection of output Channel 1	-10.25~+10.25V (Default); 0~10.25V 0~5.125V 0~21mA 4~20mA
AO_CH2_Range	Range selection of output Channel 2	
AO_ProgramModeOutput	Bit0 =0, output channel 1 retains output in program mode (default) =1, output channel 1outputs program mode value Bit1 =0, output channel 2 retains output in program mode (default) =1, output channel 1outputs program mode value Bit2~7 reserved	0 (Default) ~255
AO_FaultModeOutput	Bit0 =0, output channel 1 retains output in fault mode (default) =1, output channel 1outputs fault mode value Bit1 =0, output channel 2 retains output in fault mode (default) =1, output channel 1outputs fault mode value Bit2~7 reserved	0 (Default) ~255
AO_CH1_ProgramModeValue	Program mode value of output channel 1	0 (Default) ~65535
AO_CH2_ProgramModeValue	Program mode value of output channel 2	
AO_CH1_FaultModeValue	Fault mode value of output channel 1	

AO_CH2_FaultModeValue	Fault mode value of output channel 2	
AO_ResponseTime	Selection of output channel response time	<3ms(default); <15ms

Table 11.30: List of LK850 Configurable Static Parameters (Module Parameters)



Index	Name	Value
0	InhibitMode	Disable
1	AI_CH1_Range	-10.25~10.25V
2	AI_CH2_Range	-10.25~10.25V
3	AI_CH3_Range	-10.25~10.25V
4	AI_CH4_Range	-10.25~10.25V
5	AI_CH1_DigitalFilter	0
6	AI_CH2_DigitalFilter	0
7	AI_CH3_DigitalFilter	0
8	AI_CH4_DigitalFilter	0
9	AI_OverLimitInterruptEnable	0
10	AI_SynchronizationSample	Disable
11	TimeStampEnable	0
12	AI_OverRangeAlarmEnable	0
13	AI_OverRangeAlarmLatch	0
14	AI_LimitExceededAlarmEnable	0
15	AI_LimitExceededAlarmLatch	0
16	AI_CH1_UpperLimitValue	32767
17	AI_CH1_LowerLimitValue	0
18	AI_CH2_UpperLimitValue	32767
19	AI_CH2_LowerLimitValue	0
20	AI_CH3_UpperLimitValue	32767
21	AI_CH3_LowerLimitValue	0
22	AI_CH4_UpperLimitValue	32767
23	AI_CH4_LowerLimitValue	0
24	AI_LineBreakAlarmEnable	0
25	AI_LineBreakAlarmLatch	0
26	AO_CH1_Range	-10.25~10.25V
27	AO_CH2_Range	-10.25~10.25V
28	AO_OverloadAlarmEnable	0
29	AO_OverloadAlarmLatch	0
30	AO_ProgramModeOutput	0
31	AO_FaultModeOutput	0
32	AO_CH1_ProgramModeValue	0
33	AO_CH2_ProgramModeValue	0
34	AO_CH1_FaultModeValue	0
35	AO_CH2_FaultModeValue	0
36	AO_ResponseTime	<3ms

Figure 11.81: Configuration of LK850 Static Parameters

11.5.9 Module Installation and Un-installation

Refer to chapter 1 on "Module Insertion Mechanical keys" and "Module Insertion and Removable" for more details.

11.5.10 Technical Specification

LK850 4-Channel AI and 2-Channel AO Non-Isolation High-speed Analog Module					
Backplane Power Supply					
Input Voltage	24VDC (-15% ~ +20%)				
Power Consumption	180mA@24VDC				
Isolation Voltage					
Field to System	500V AC 1min Testing, Current Leak 5mA				
Input Channel					
Number of Channels	4 channels				
Signal Type	Voltage and/or current differential input				
Signal range	Range Code	Measurement Range	Decimal Code Value	Measurement Precision after Calibration (F.S.)	
				filter	Non filter
Voltage Signal	16	-10.25V~1LSB (-1LSB represent the minimum resolution of (-10.25~10.25V) voltage range, with a code value 65535 that corresponds to -0.0006485V voltage signal.)	49730~65535	<0.1%	<0.3%
		0~+10.25V	0~15805		
	17	0~+10.25V	0~15805	<0.2%	<0.6%
	18	0~+5.125V	0~7903	<0.3%	<0.9%
Current Signal	71	4~20.58mA	1523~7838	<0.3%	<0.8%
	70	0~20.58mA	0~7838	<0.3%	<0.8%
Input Impedance	Voltage input	>1MΩ			
	Current Input	247Ω			
Integral Mode Suppression Rate	>70dB@50/60Hz				
Step Response Time	<1ms				
Full Channel Scan Period	400µs				
Calibration Period	12 months				
Temperature Drift (max.)	Voltage input	±25ppm/°C			
	Current Input	±35ppm/°C			
Measurement Precision within Work Range	Range Code	Measurement Range		Measurement Precision (F.S.)	
				filter	Non filter
	16	-10.25~+10.25V		<0.2%	<0.4%
	17	0~+10.25V		<0.3%	<0.7%
	18	0~+5.125V		<0.4%	<1.0%
	71	4~20.58mA		<0.4%	<0.9%
	70	0~20.58mA		<0.4%	<0.9%
Repentance Precision	0.05%				
Output Channel					
Number of Channels	2 channels				
Signal Type	Voltage and / or current				
Signal range	Range Code	Output Range	Decimal Code Value	Output Precision after Calibration (F.S., output response time <15ms)	
Voltage Signal	16	-10.25~+10.25V	3248~62287	<0.1%	

	17	0~+10.25V	32768~62287	<0.2%
	18	0~+5.125V	32768~47527	<0.3%
Current Signal	68	4~20mA	38527~61567	<0.2%
	69	0~21mA	32768~63007	<0.2%
Output over-current protection	Only for current output, maximum output current <25mA			
Establishment Time (max.)	Resistance load	1ms；		
	Capacity load	1.5ms；		
	Inductive load	1ms；		
Drive Capability	Load	Voltage Output	Current Output	
	Resistance load	>2000Ω	0~600Ω	
	Capacity load	<1μF	-	
	Inductive load	-	<1mH	
Calibration Period	12 months			
Temperature Drift (max.)	Voltage Output	±25ppm/°C		
	Current Output	±35ppm/°C		
Output Precision within Work Range	Range Code	Output Range	Output Precision (F.S.)	
			Output response time<3mS	Output response time<15mS
	16	-10.25~+10.25V	<3%	<0.2%
	17	0~+10.25V	<4%	<0.3%
	18	0~+5.125V	<5%	<0.4%
	68	4~20mA	<3%	<0.3%
	69	0~21mA	<3%	<0.3%
Repentance Precision	0.05%			
Failure Diagnosis and Hot Swamp				
Limit Exceeded Alarm	Signal range exceeded Alarm upper/lower limits, diagnosis byte reports 0x01/0x02			
Measurement Range Exceeded Alarm	Signal exceeded range upper/lower limits, diagnosis byte reports 0x04/0x08			
Line-Break Detection	Line-break in the input channel, diagnosis byte reports 0x10, channel measurement data reports 32767 (voltage) or 0 (current).			
Over-load Detection	Output channel over-load, channel diagnosis byte reports 0x10			
Hot Swap	Support			
Communication Bus				
Protocol	HollySys proprietary protocol			
Baud Rate	32Mbps			
Media	Communication bus is connected to the backplane through euro connector			
Physical Features				
Mechanic Keys to Prevent Incorrect Insertion	F0			
Installation	Installation on backplane slot			
Installation Location	LK local backplane			
Dimensions	Width × Height × Depth = 35mm×100mm×100mm			
Casing Protection Level	IEC60529 IP20			
Weight	180g			
Working Environment				
Working temperature	0~60°C			
Working Relative Humidity	5%~95%, no condensate			
Storage Temperature	-40~85°C			
Storage Temperature	5%~95%, no condensate			

Table 11.31: Technical Specification of LK850 Module

Chapter
12

CHAPTER 12: TERMINAL MODULE

12.1 LK3310 UNIVERSAL TERMINAL MODULE

12.1.1 Features

- This module is used together with other I/O modules. Different I/O modules correspond to different wiring methods.
- The double row terminals are connected to field signals, and D sockets are connected to LK cable backplanes.
- Standard rail installation
- Width x height x depth = 108.5mm×100mm×67.5mm

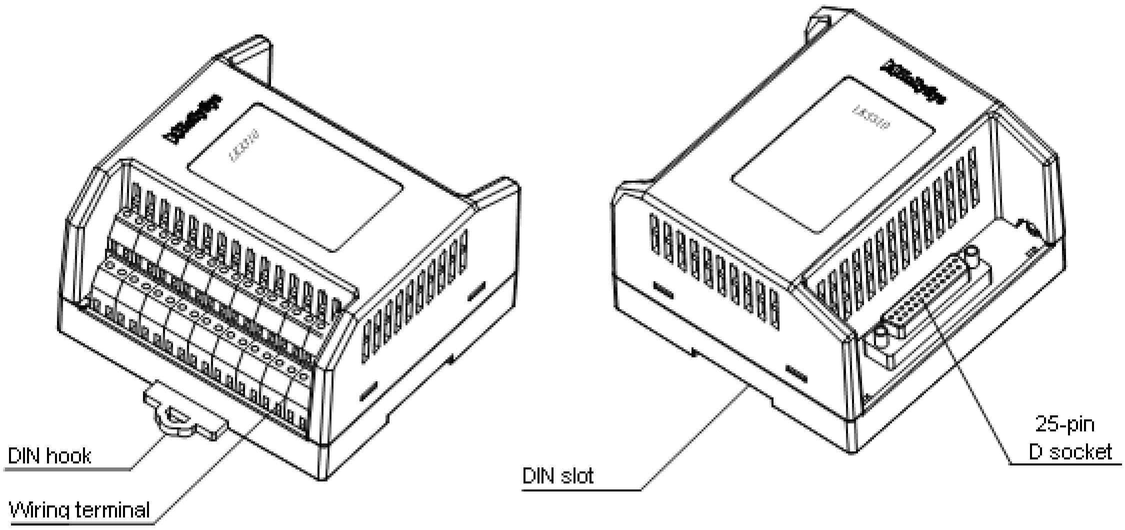


Figure 12.1: Exterior of LK3310 terminal modules

12.1.2 Wiring Specification

Using LK3310 with LK610/LK650 (sink DI)

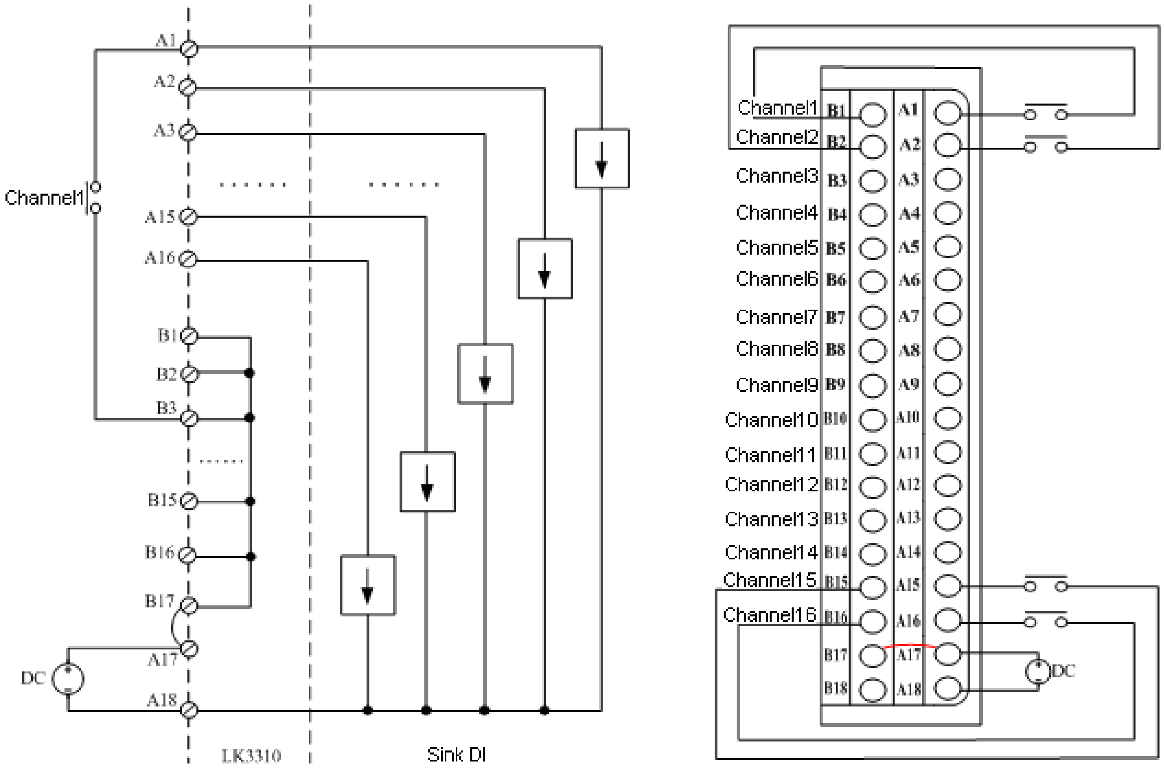


Figure 12.2: Wiring LK3310 with LK610/LK650

In the wiring, the following shall be noted:

- Connect to a separated external 24VDC field power supply.
- 16 channel contacts share one field power supply.
- Every channel of DI is connected to terminals through 2 cables. "A1~A16" and "B1~B16" are the input ends of channel 1~16DI
- Connected inside of LK3310, "Bn" is the common end of 16 channels DI.
- "A17" and "B17" connect to the positive end of field power supply while "A18" connects to the negative end.

Using LK3310 with LK611/LK612/LK651/LK652 (source DI)

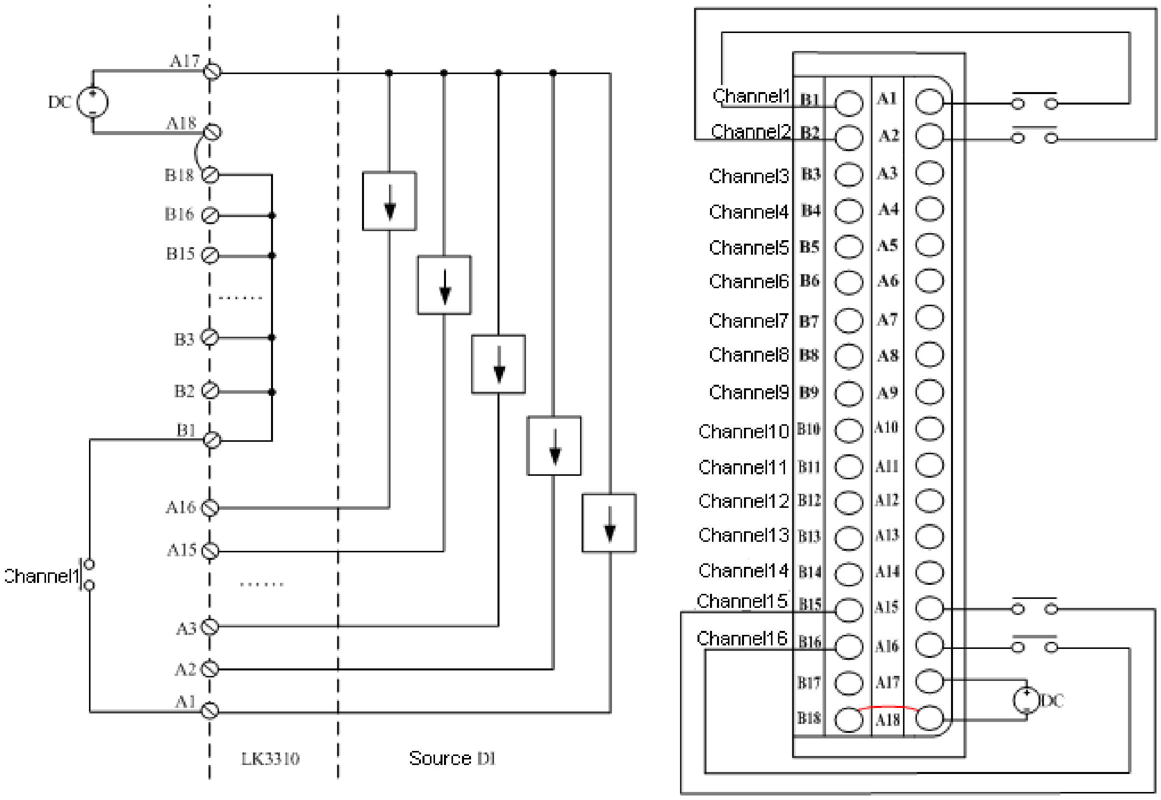


Figure 12.3: Wiring LK3310 with LK611/LK612/LK651/LK652

In the wiring, the following shall be noted:

- LK611/LK651 shall connect to separate external 24VDC field power supply.
- LK612/LK652 shall connect to separate external 48VDC field power supply.
- 16 channel contacts share one field power supply.
- Every channel of DI is connected to terminals through 2 cables. “A1~A16” and “B1~B16” are the input ends of channel 1~16DI
- Connected inside of LK3310, “Bn” is the common end of 16 channels DI.
- “A17” connects to the positive end of field power supply while “A18” and “B18” connect to the negative end.

Using LK3310 with LK613/LK614/LK615 (AC DI)

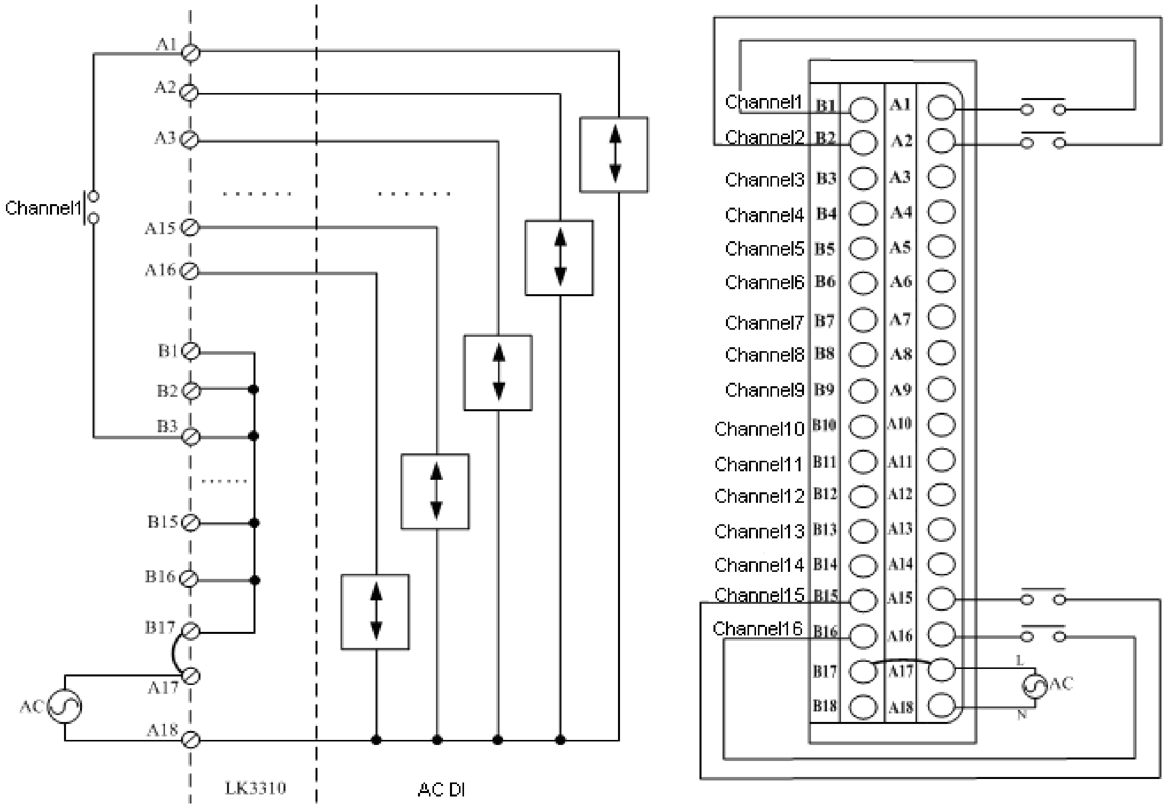


Figure 12.4: Wiring LK3310 with LK613/LK614/LK615

In the wiring, the following shall be noted:

- LK613 shall connect to 14VAC~27VAC field power supply.
- LK614 shall connect to 74VAC~132VAC field power supply.
- LK615 shall connect to 159VAC~265VAC field power supply.
- 16 channel contacts share one field power supply.
- Every channel of DI is connected to terminals through 2 cables. “A1~A16” and “B1~B16” are the input ends of channel 1~16DI
- Connected inside of LK3310, “Bn” is the common end of 16 channels DI.
- “A17” and “B17” connect to the L end of field power supply while “A18” connects to the N end.

Using LK3310 and LK630 (SOE) for controller clock synchronization

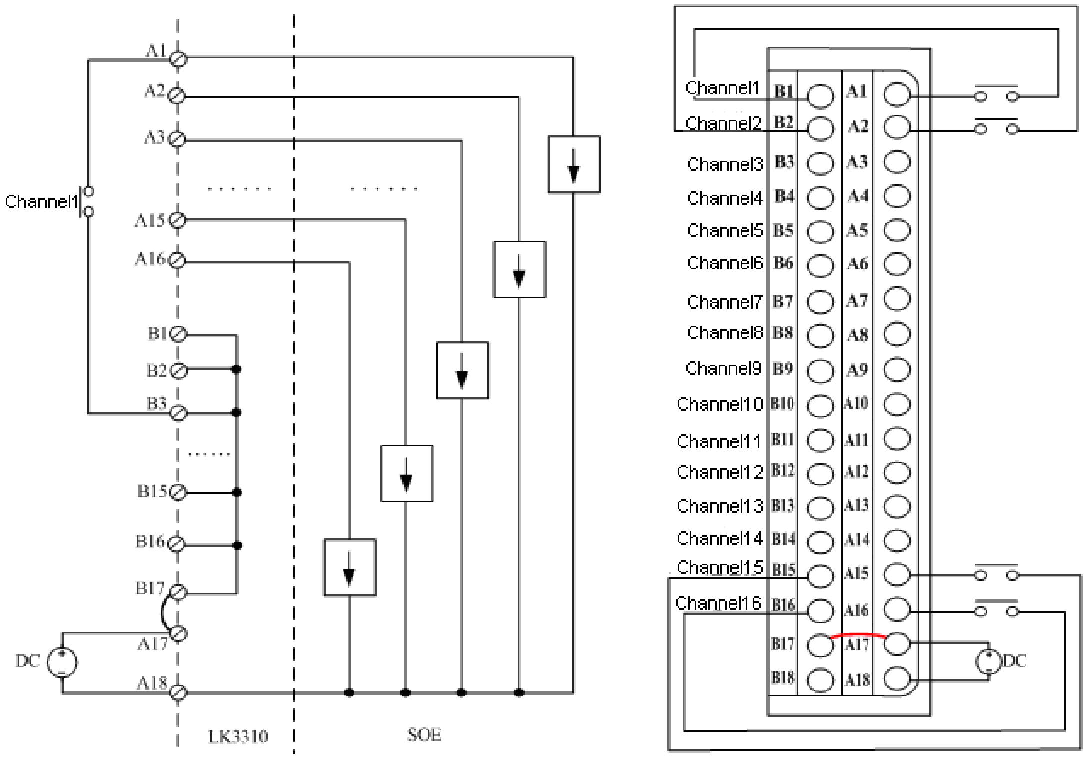


Figure 12.5: Wiring LK3310 with LK630 (controller clock synchronization)

In the wiring, the following shall be noted:

- Connect to separate external 24VDC field power supply.
- 16 channel SOE signals share one field power supply.
- Every channel of SOE signals is connected to terminals through 2 cables. “A1~A16” and “B1~B16” are the input ends of channel 1~16 SOE signals
- Connected inside of LK3310, “Bn” is the common end of 16 channel SOE signals
- “A17” and “B17” connect to the positive end of field power supply while “A18” connects to the negative end.

Using LK3310 with LK630 (GPS clock synchronization)

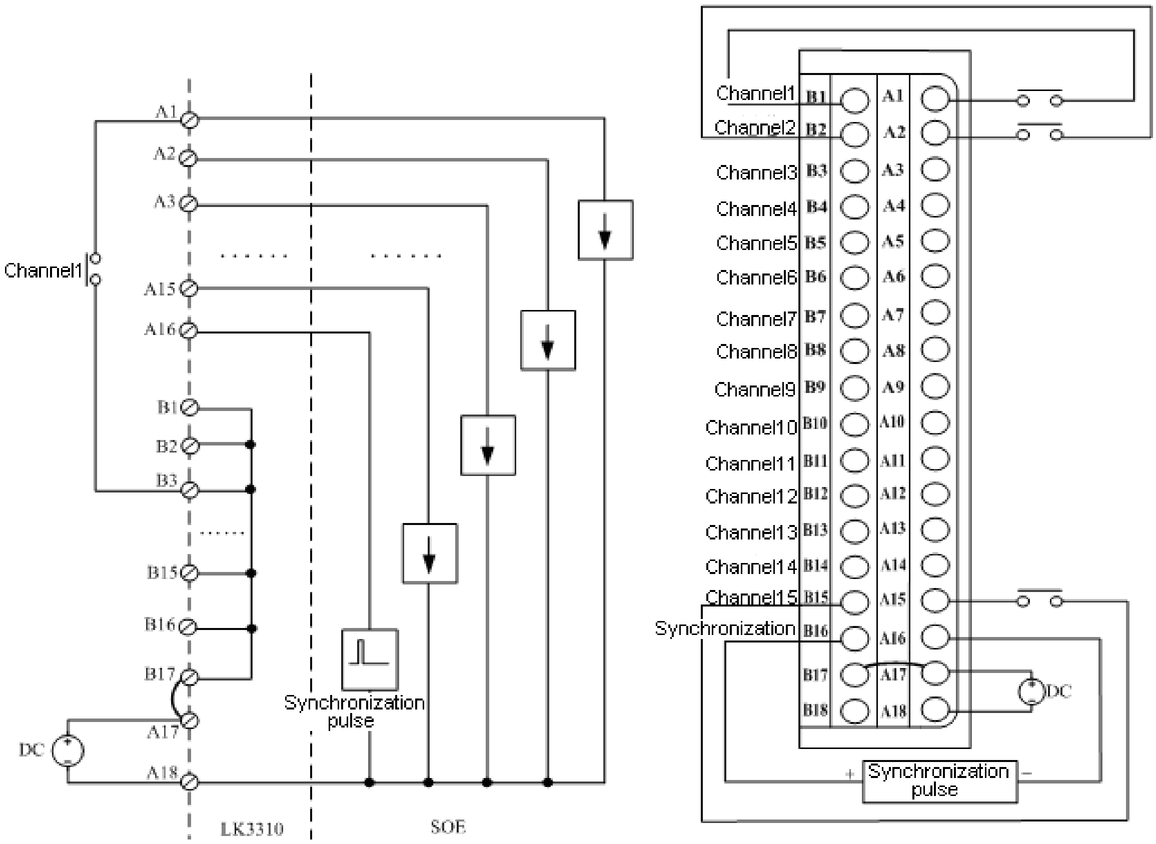


Figure 12.6: Wiring LK3310 with LK630 (GPS clock synchronization)

In the wiring, the following shall be noted:

- Connect to separate external 24VDC field power supply.
- 16 channels (15channels of SOE signals and 1 channel synchronization signals) share one field power supply.
- Every channel of SOE signals is connected to terminals through 2 cables. "A1~A15 and "B1~B15 are the input ends of channel 1~15SOE signals
- Channel 16 (A16, B16) are synchronization channel that connects to pulse signals for the system synchronization.
- Connected inside of LK3310, "Bn" (B1~B17) is the common end of 16 channel inputs.
- "A17" and "B17" connect to the positive end of field power supply while "A18" connects to the negative end.

Using LK3310 with LK710/LK750 (source DI)

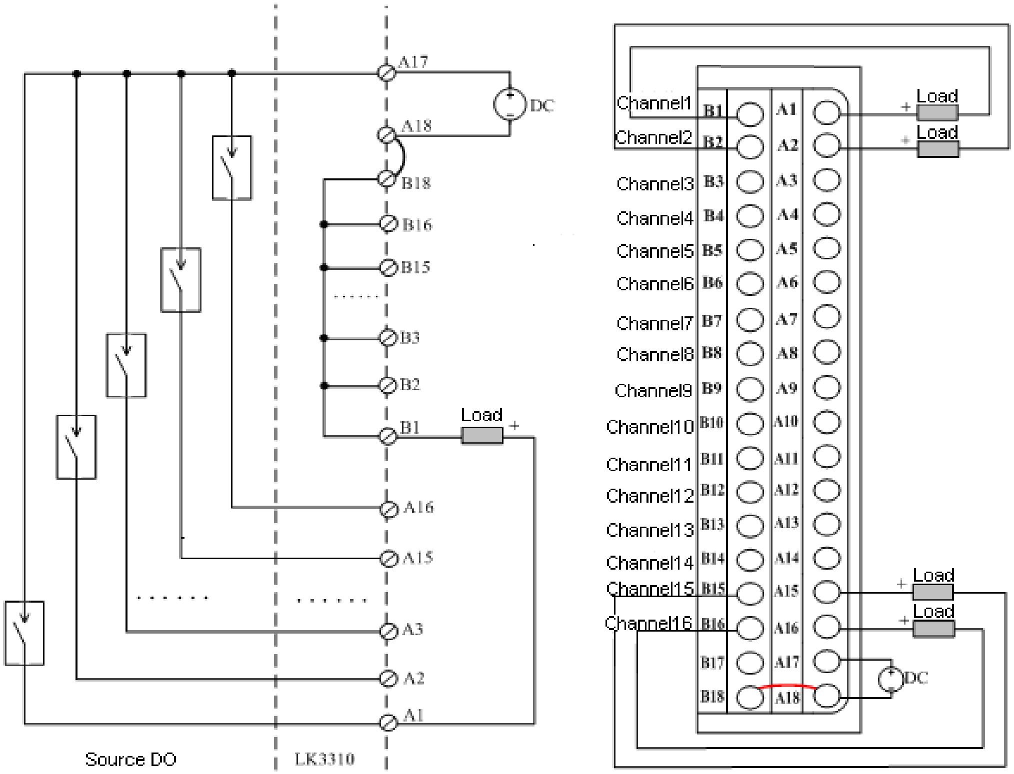


Figure 12.7: Wiring LK3310 with LK710/LK750

In the wiring, the following shall be noted:

- Connect to separated external 24VDC field power supply.
- 16 channel contacts share one field power supply.
- Every channel of output is connected to the load by 2 cables, "A1~A16" are the positive ends of Channel1~16 DO while "B1~B16" are the negative ends.
- Connected inside of LK3310, "Bn" (B1~B17) is the common end of 16 channel inputs.
- "A17" connects to the positive end of field power supply while "A18" and "B18" connect to the negative end.

Using LK3310 with LK711/LK712 (TRIAC DO)

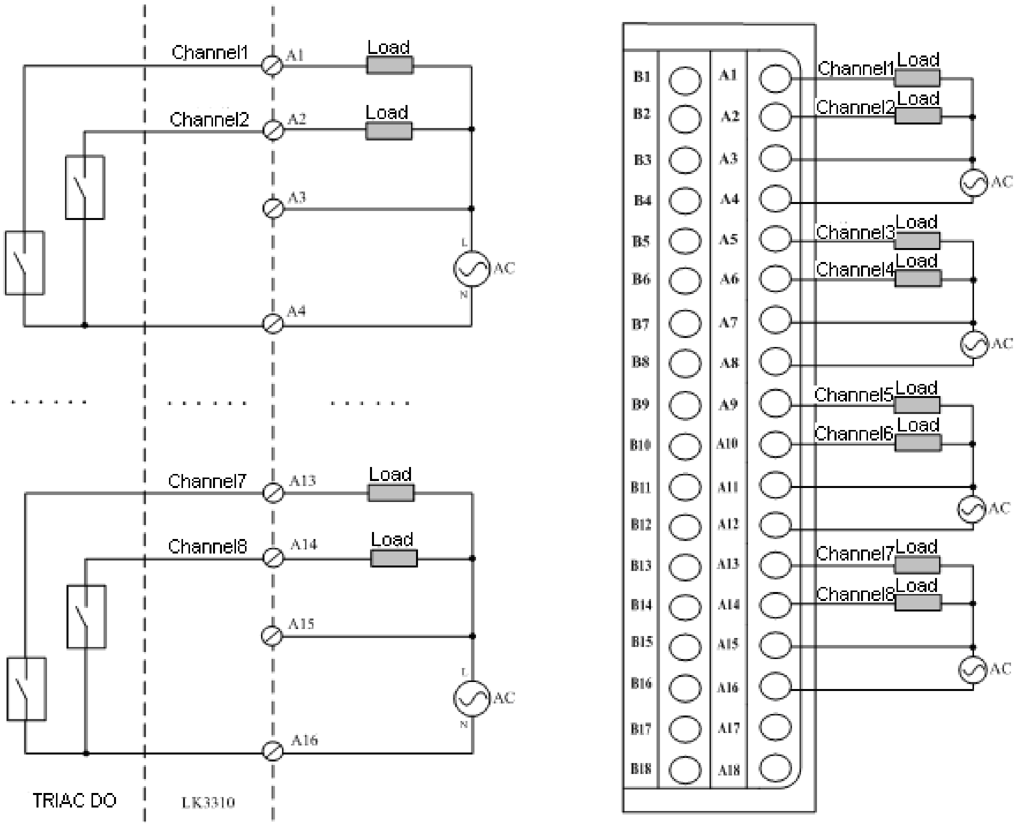


Figure 12.8: Wiring LK3310 with LK711/LK712

In the wiring, the following shall be noted:

- LK711 shall connect to 10VAC~60VAC field power supply.
- LK712 shall connect to 74VAC~265VAC field power supply.
- Output channels are divided into 4 groups. Each group (2 channels) share 1 field power supply.
- Connected inside of LK3310, "Bn" (B1~B17) is the common end of 16 channel digital outputs.

Using LK3310 with LK720/LK721 (Relay DO)

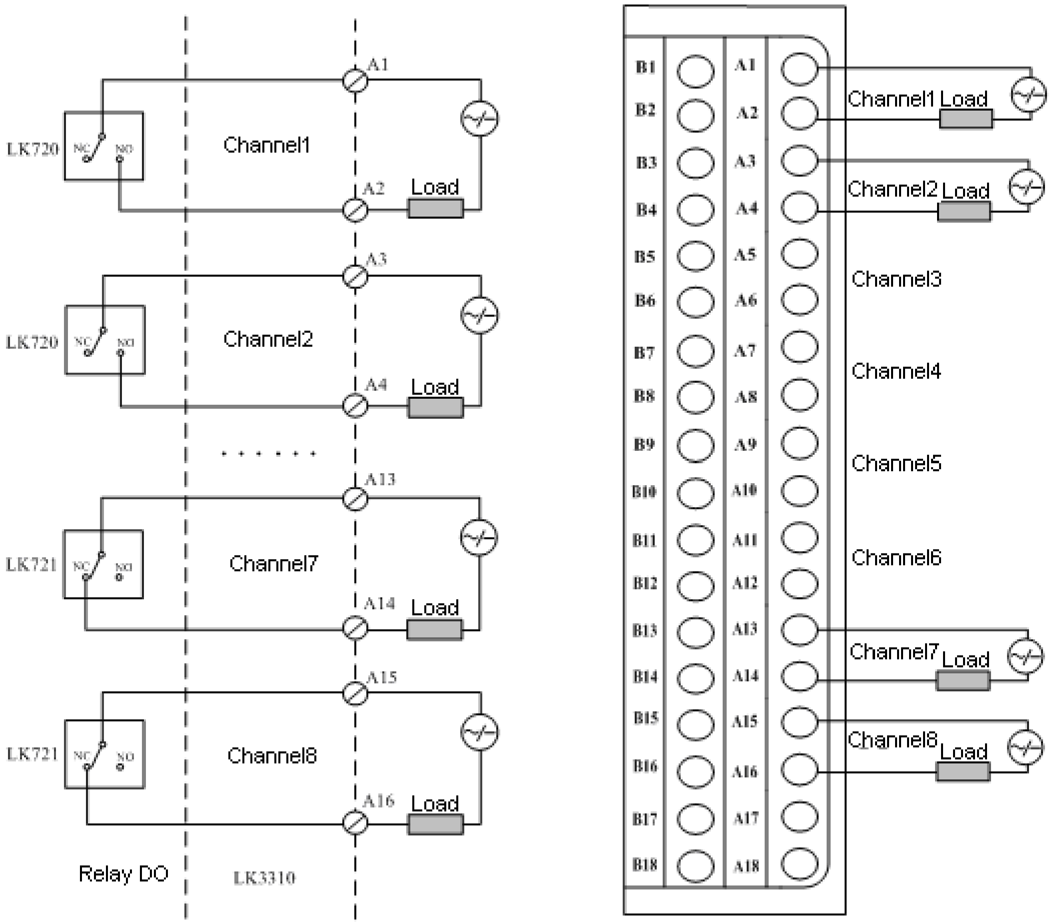


Figure 12.9: Wiring LK3310 with LK720/LK721 (multiple power supplies)

In the wiring, the following shall be noted:

- Connect to external 10VAC~256VAC or 5VDC~125VDC field power supply.
- LK720 non source open contact outputs
- LK721 non source close contact outputs
- Inter-channel isolation, each channel uses 1 field power supply

Using LK3310 with LK720/LK721 (single power supply)

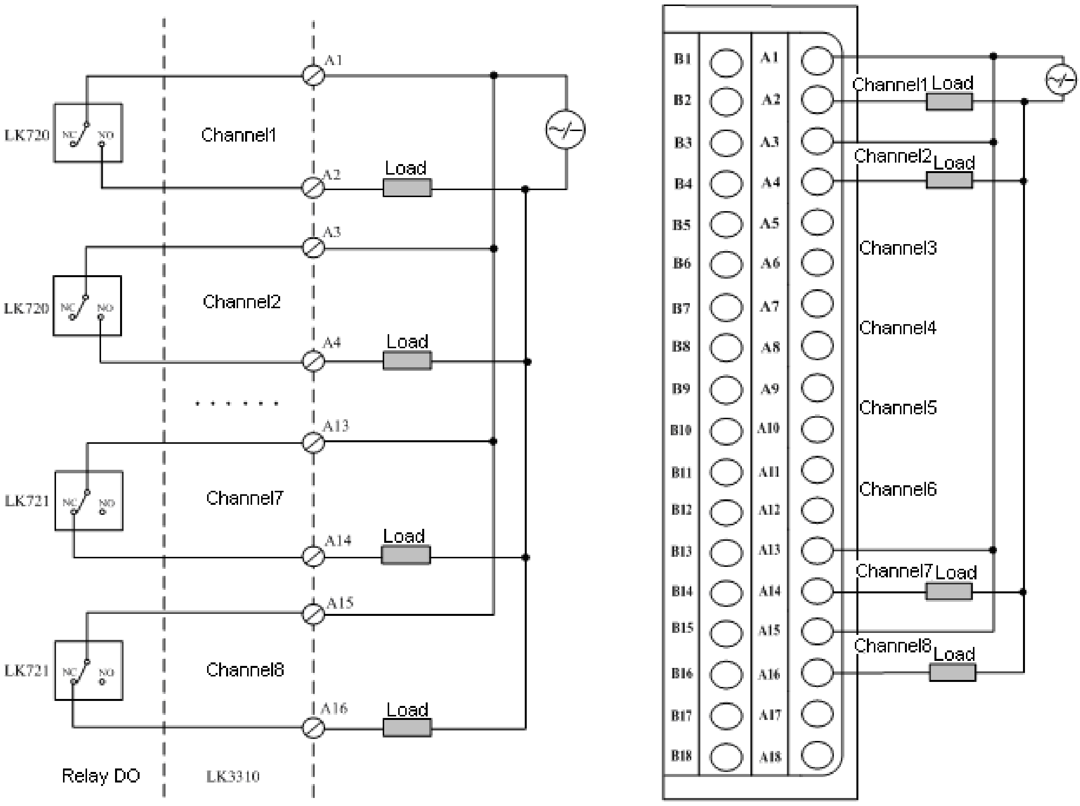


Figure 12.10: Wiring LK3310 with LK720/LK721 (single power supply)

In the wiring, the following shall be noted:

- Connect to external 10VAC~256VAC or 5VDC~125VDC field power supply.
- LK720 non source open contact outputs
- LK721 non source close contact outputs
- 8 channels share 1 field power supply.

Using LK3310 with LK410

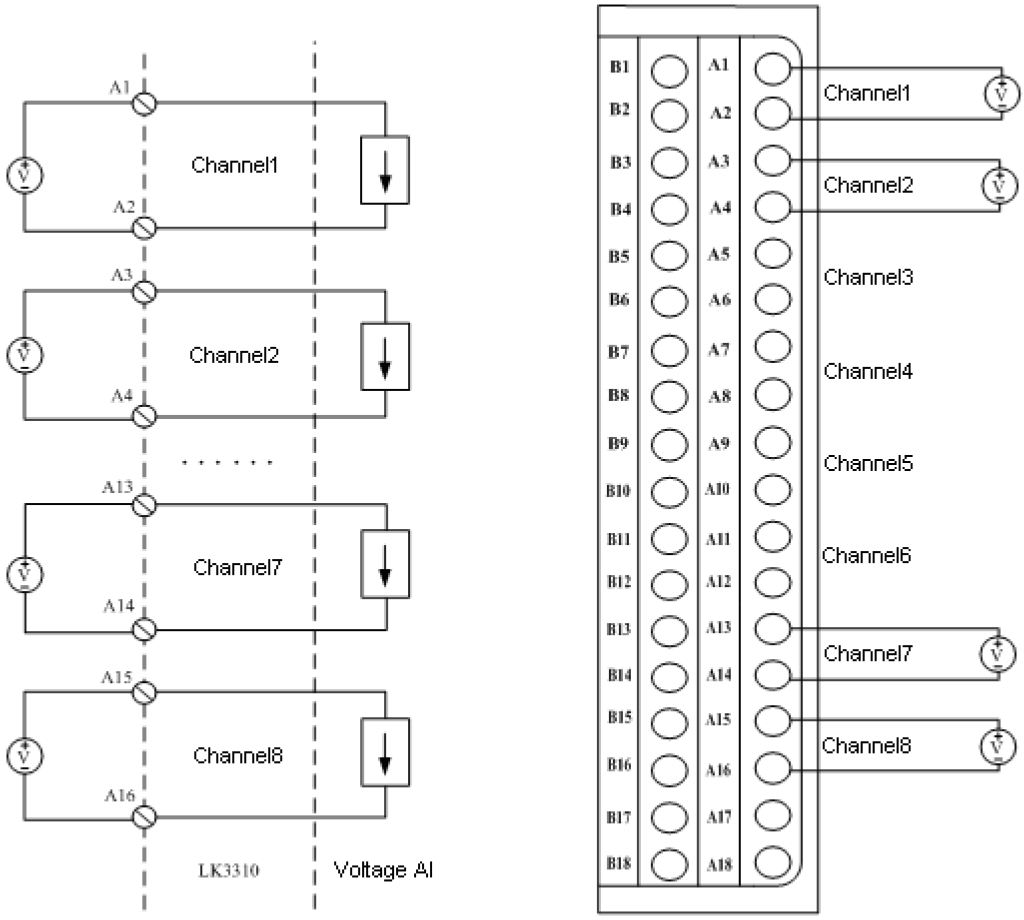


Figure 12.11: Wiring LK3310 with LK410

In the wiring, the following shall be noted:

- The odd-number terminals connect to the positive ends of voltage signals while the even-number terminals connect to the negative ends.
- "A17" and "A18" are not in use.
- Terminals on column B are not in use.

Using LK3310 with LK411

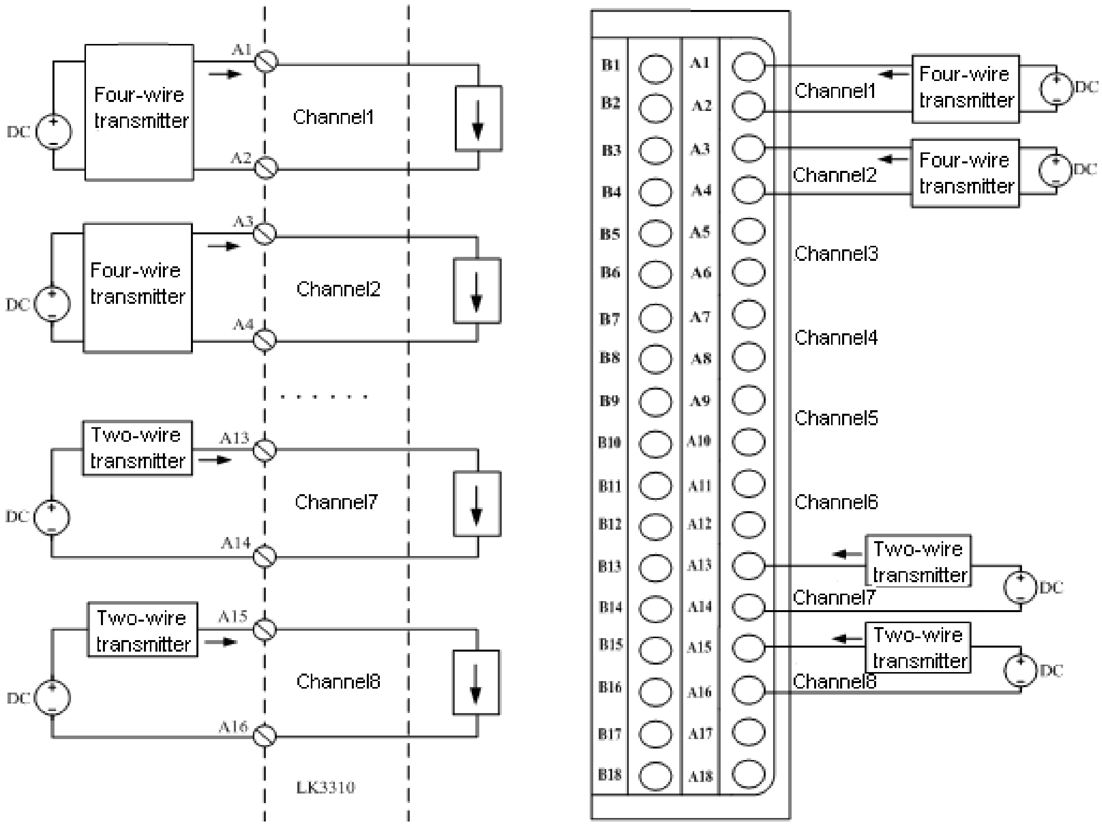


Figure 12.12: Wiring LK3310 with LK411

In the wiring, the following shall be noted:

- Input channels do not supply power to transformers. .
- “A17” and “A18” are not in use.
- Terminals on column B are not in use.

Using LK3310 with LK414

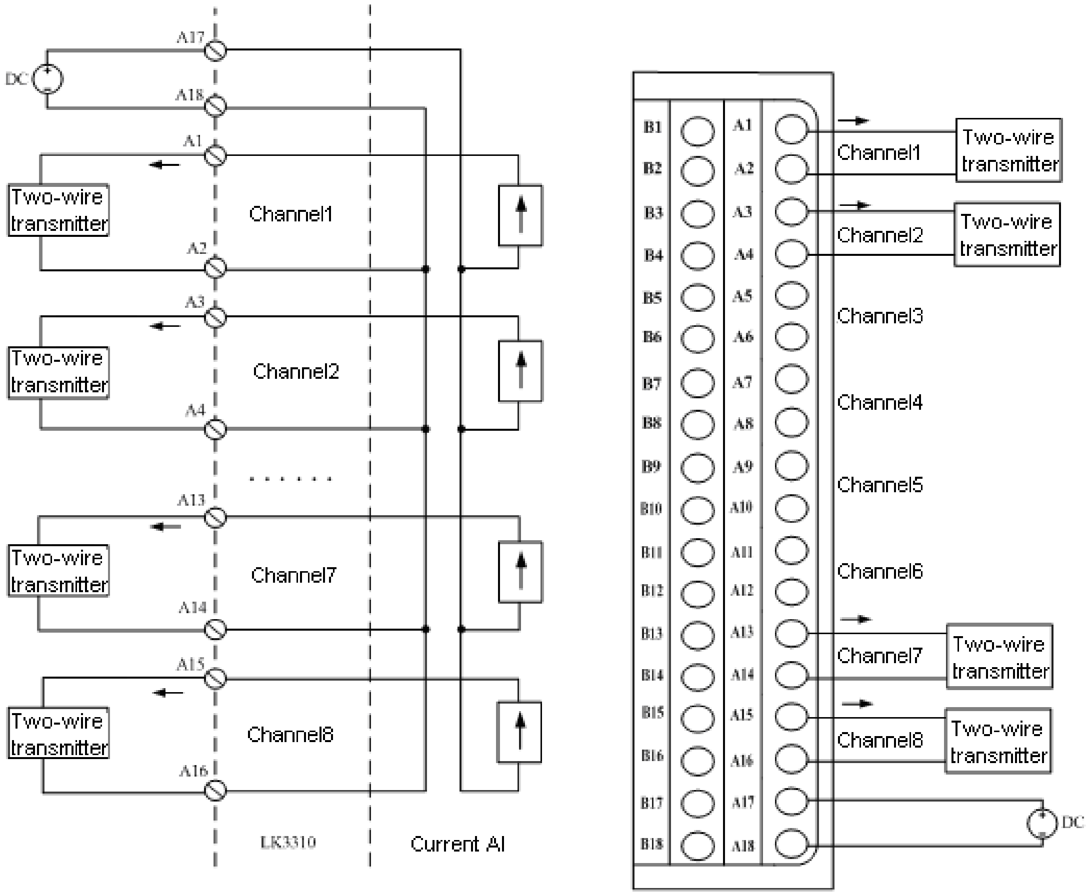


Figure 12.13: Wiring LK3310 with LK414

In the wiring, the following shall be noted:

- Connect to a separated external 24VDC field power supply.
- "A17" connects to the positive end of field power supply while "A18" connects to the negative end.
- Terminals on column B are not in use.

Using LK3310 with LK415

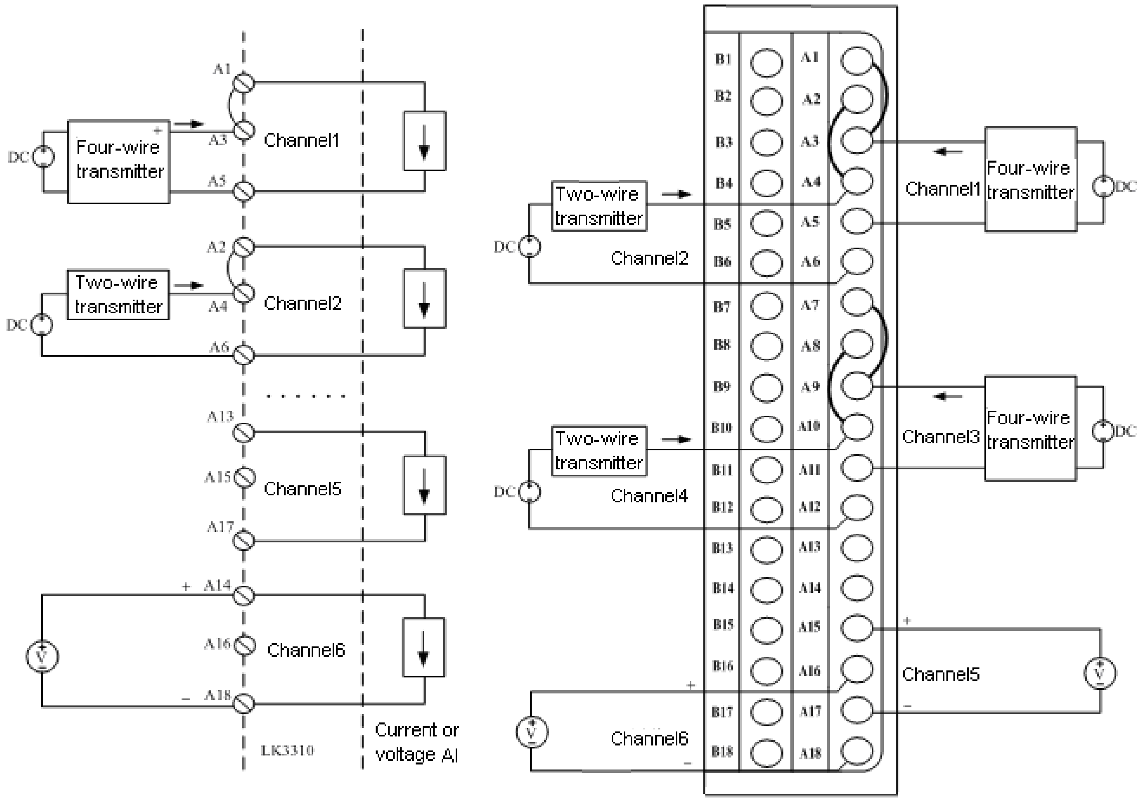


Figure 12.14: Wiring LK3310 with LK412/LK415

In the wiring, the following shall be noted:

- In current input, channels do not supply power to transformers. .
- Terminals on column B are not in use.

Using LK3310 with LK430

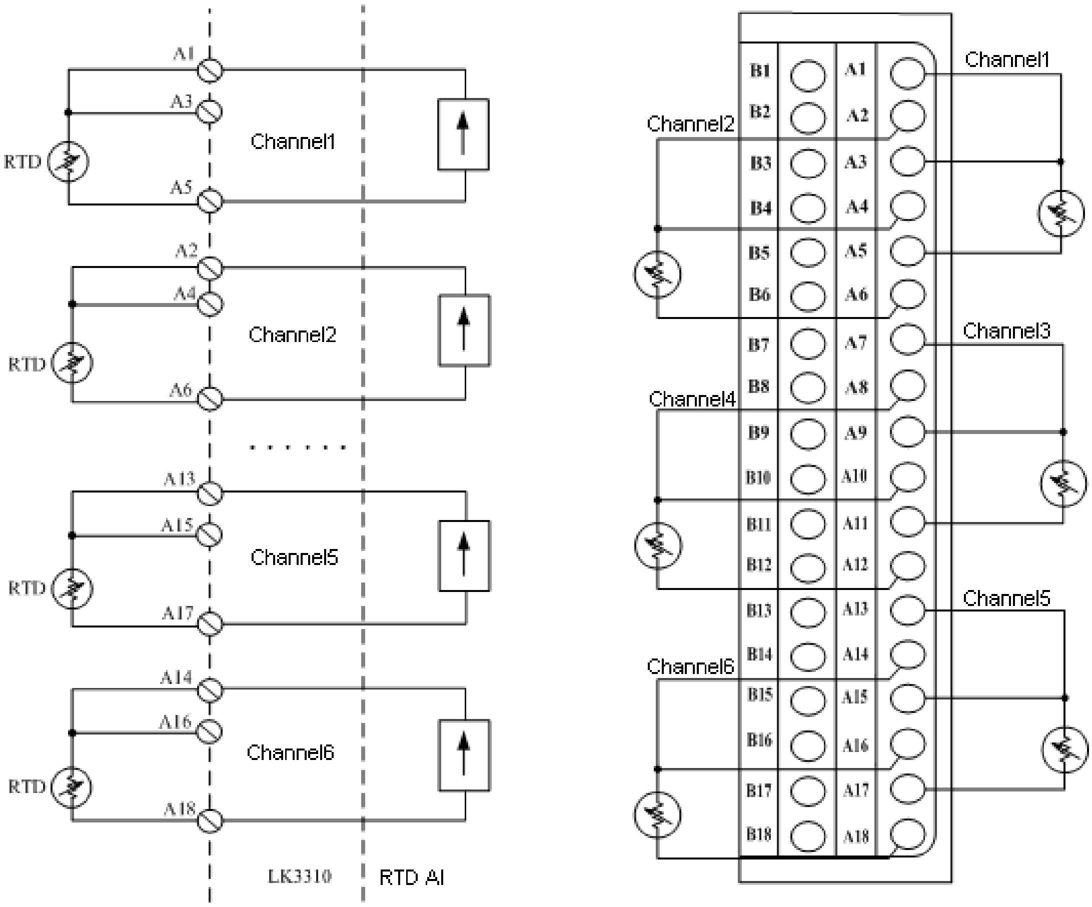


Figure 12.15: Wiring LK3310 with LK430

In the wiring, the following shall be noted:

- Every channel of RTD signals is connected to the terminal by 3 cables.
- Terminals on column B are not in use.

Using LK3310 with LK440

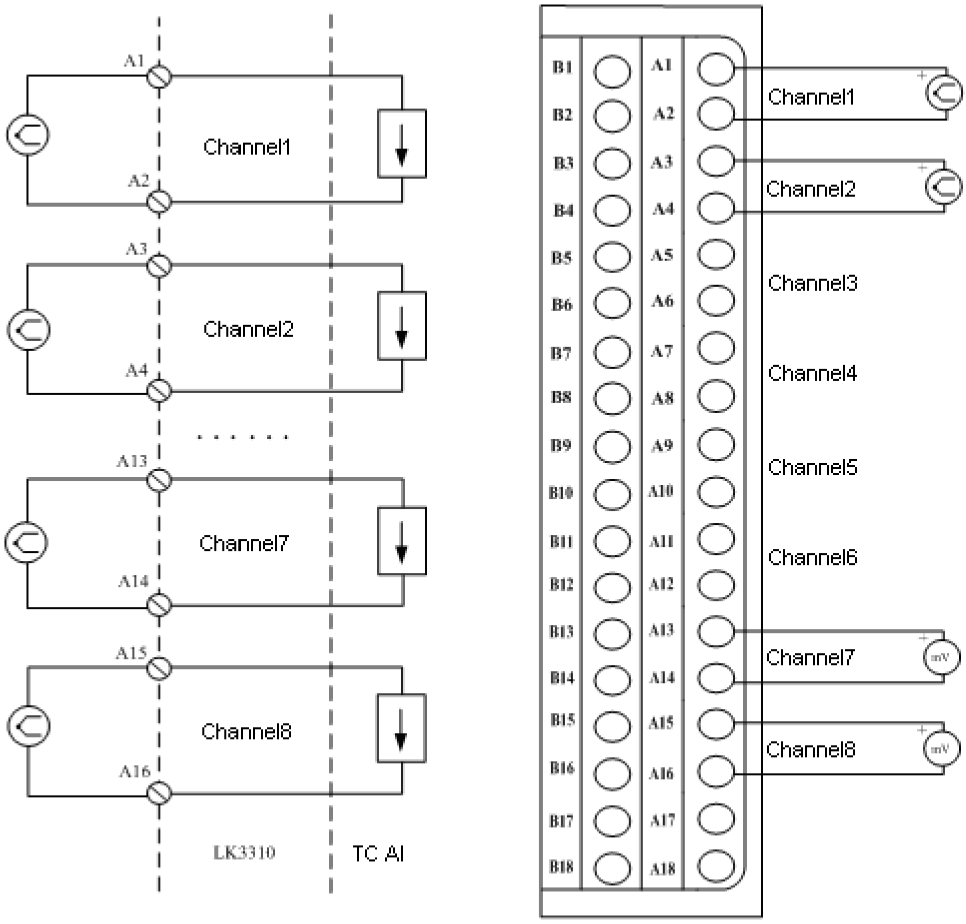


Figure 12.16: Wiring LK3310 with LK440

In the wiring, the following shall be noted:

- Odd number Terminals are the positive ends of thermocouple or millivolt signals.
- Even number Terminals are the negative ends of thermocouple or millivolt signals.
- "A17" and "A18" are not in use.
- Terminals on column B are not in use.

Using LK3310 with LK441

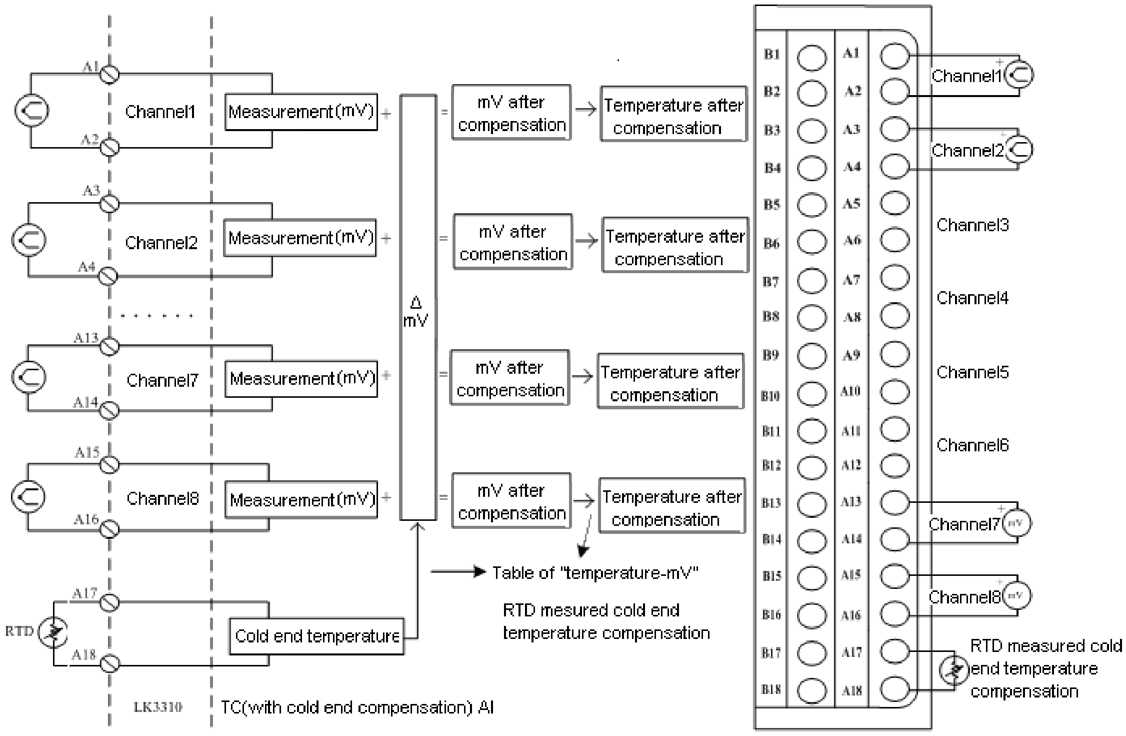


Figure 12.17: Wiring LK3310 with LK441

In the wiring, the following shall be noted:

- Odd number Terminals are the positive ends of thermocouple or millivolt signals.
- Even number Terminals are the negative ends of thermocouple or millivolt signals.
- "A17" and "A18" connect to RTD components for cold junction compensation.
- Terminals on column B are not in use.

Using LK3310 with LK510

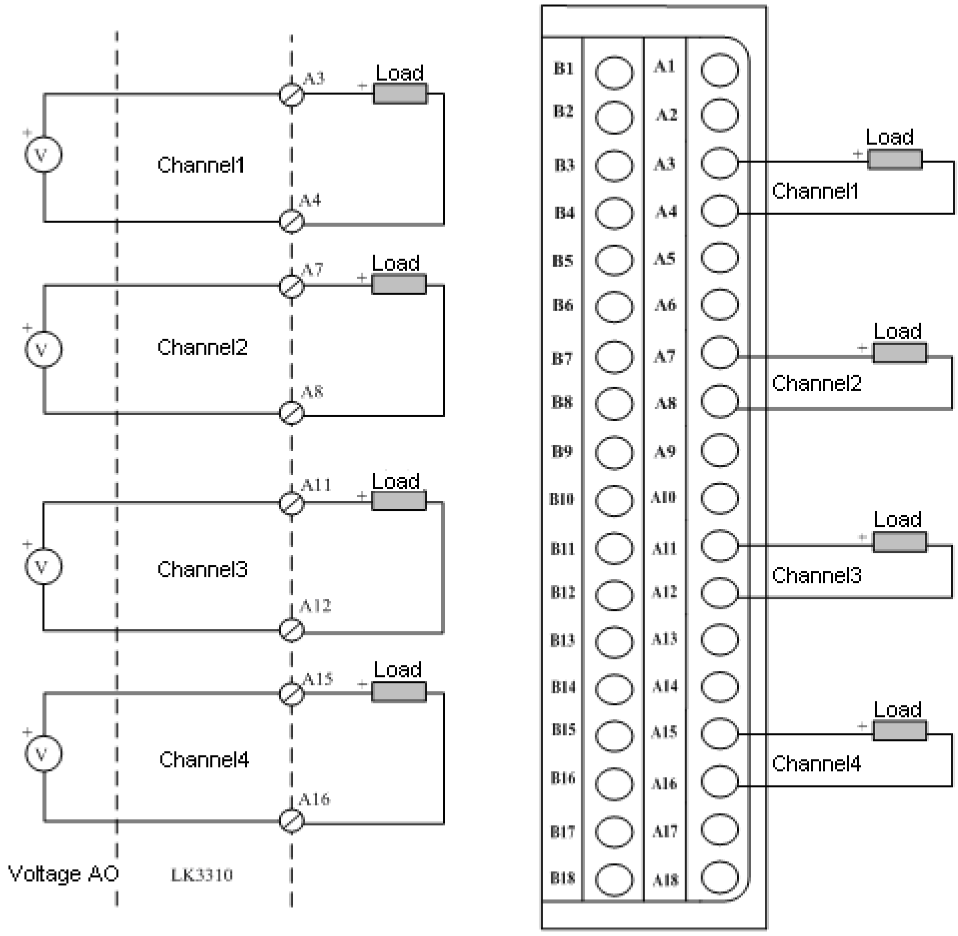


Figure 12.18: Wiring LK3310 with LK510

In the wiring, the following shall be noted:

- Odd number Terminals are the positive ends of voltage signal outputs.
- Even number Terminals are the negative ends of voltage signal outputs.
- “A17” and “A18” are not in use.
- Terminals on column B are not in use.

Using LK3310 with LK511

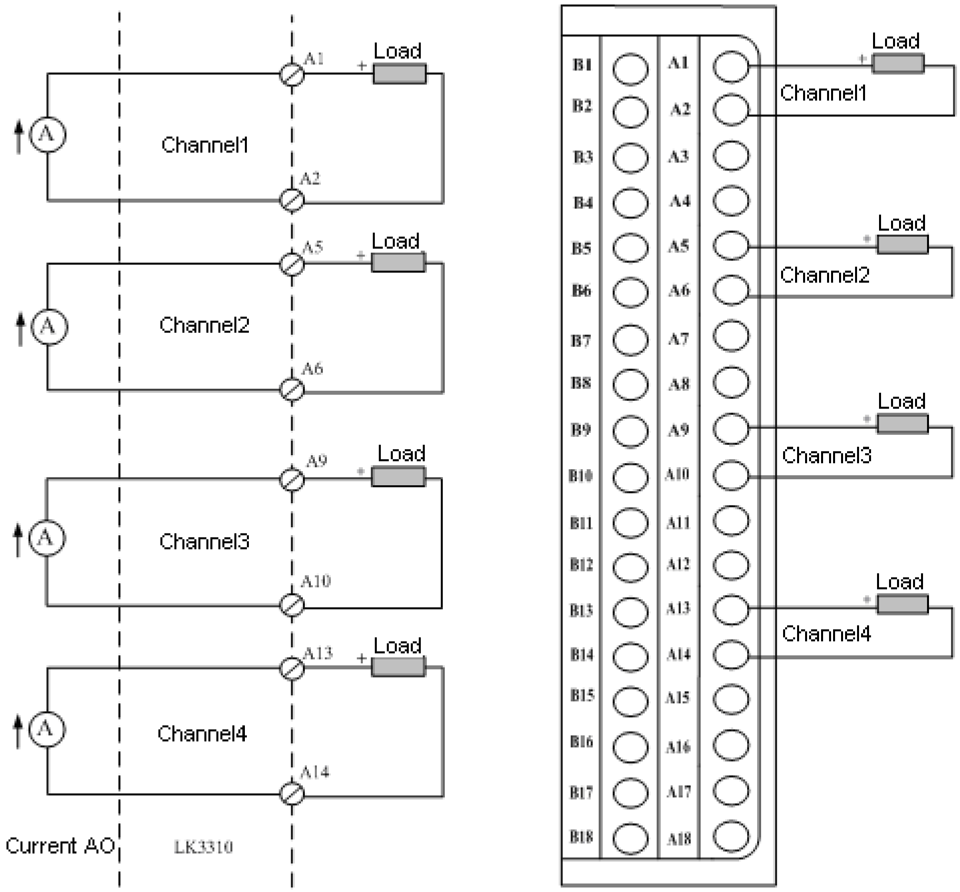


Figure 12.19: Wiring LK3310 with LK511

In the wiring, the following shall be noted:

- Odd number Terminals are the output ends of current signals.
- Even number Terminals are the input ends of current signals.
- "A17" and "A18" are not in use.
- Terminals on column B are not in use.

Using LK3310 with LK810/850

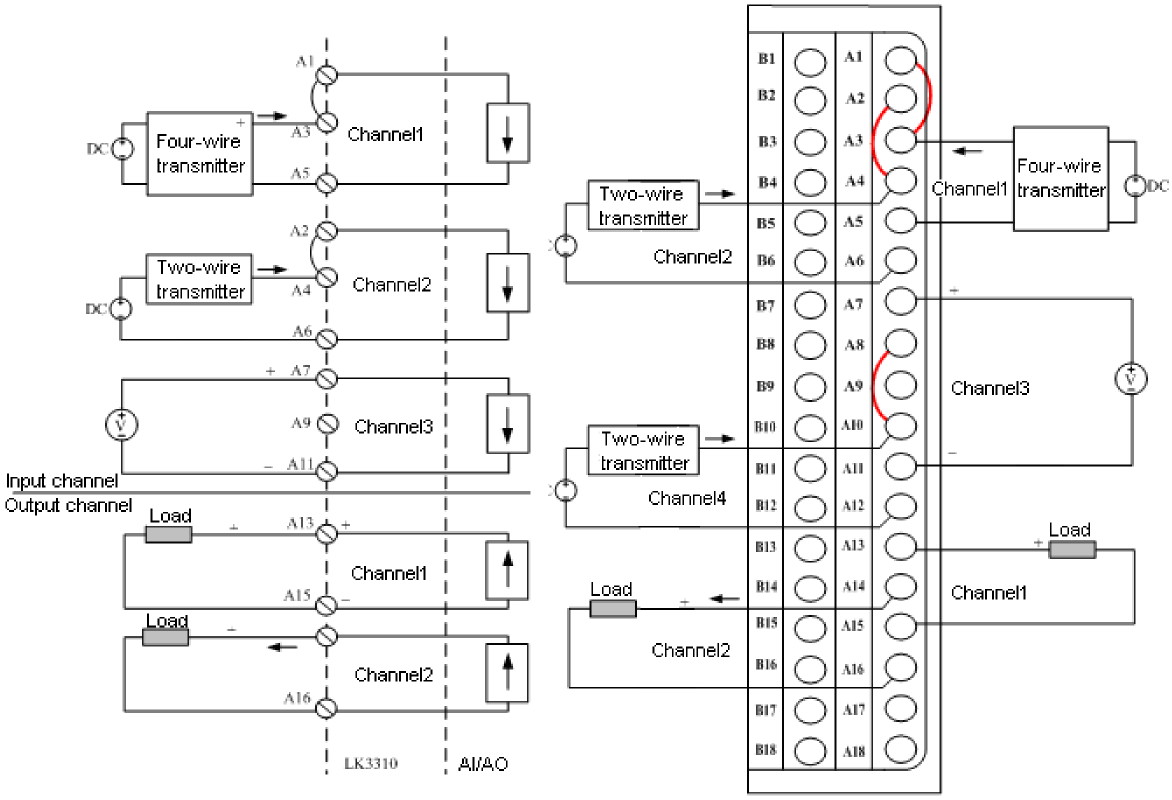


Figure 12.20: Wiring LK3310 with LK810/LK850

In the wiring, the following shall be noted:

- Current input channels do not supply power to external devices.
- “A17” and “A18” are not in use.
- Terminals on column B are not in use.

Using LK3310 with LK680

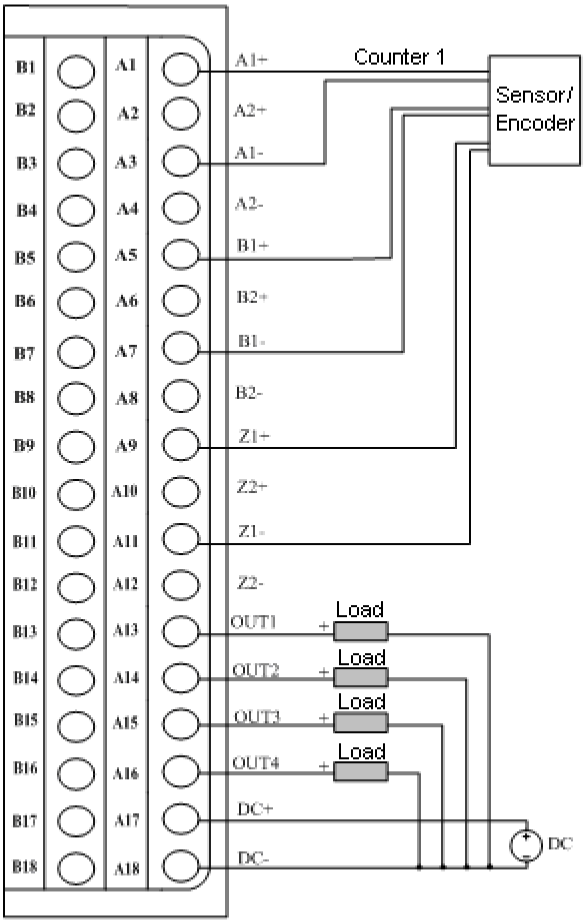


Figure 12.21: Wiring LK3310 with LK680

12.2 INSTALLATION GUIDE

12.2.1 Cable Installation

The wiring terminals of one side of the terminal module use 18 double row screw terminals with fixed M3 screws. The wire clip is suitable for cables of diameters ranging from AWG24~12/0.2~2.5mm2, with a stripped length of 8mm/0.315in. On the other side, the D socket can be connected to LK special cable.

Installing the D socket

1. Use a flathead screwdriver to loosen the screws on the terminal, insert the signal cable into the clip hole below the terminal, and fasten the screw with the flathead screwdriver.
2. Insert the 25-pin plug of the cable into the D socket of the terminal module.
3. After it is firmly in position, fasten the screws at the two ends of the cable plug.

Removing the D socket

1. Use a flathead screw driver to loosen the screw on the terminal, and remove the signal cable from the clip hole.
2. Loosen the screws on the cable plug, and remove it from the D socket of the terminal module.

12.2.2 Terminal Module Installation

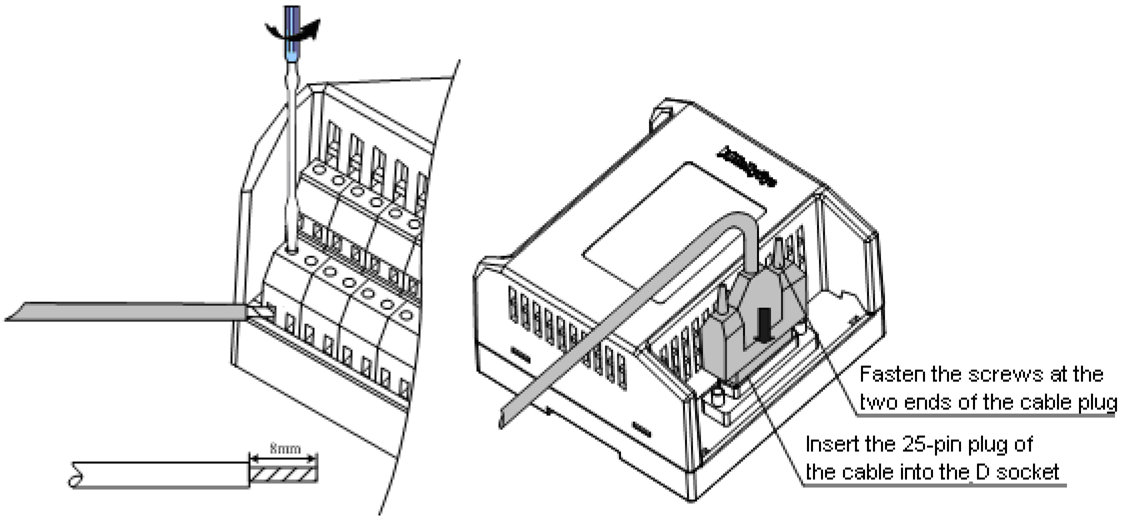


Figure 12.22: Wiring the double row terminals on the module

Wiring on the terminal

1. Pull the clip at the bottom of the terminal module so that it is revealed.
2. Fit one side of the rail into the clip at the bottom of the terminal module.
3. Push the module in so that the rail is entirely inside the clip slot.

Removing the wiring on the terminal

1. Pull the clip at the bottom of the terminal module so that it is revealed.
2. Remove the terminal module from the rail.

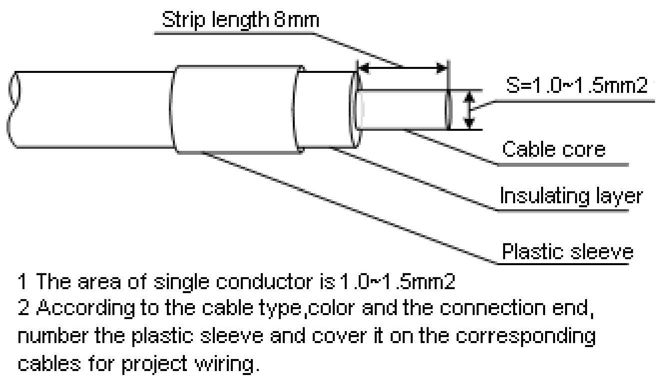


Figure 12.23: Signal cabling requirement

Installing the terminal module on the rail

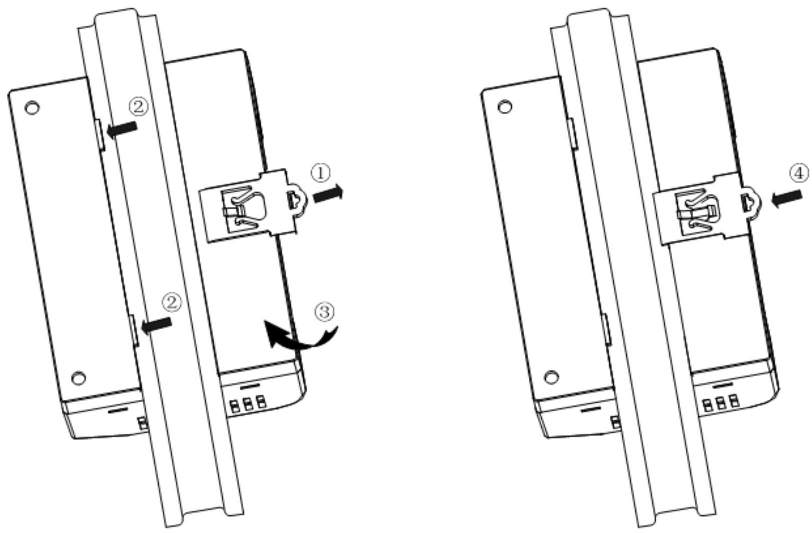


Figure 12.24: Installing the terminal module on the rail

1. Pull the rail clip to unlock and push the rail clip to lock its position.

Uninstalling the terminal module from the rail

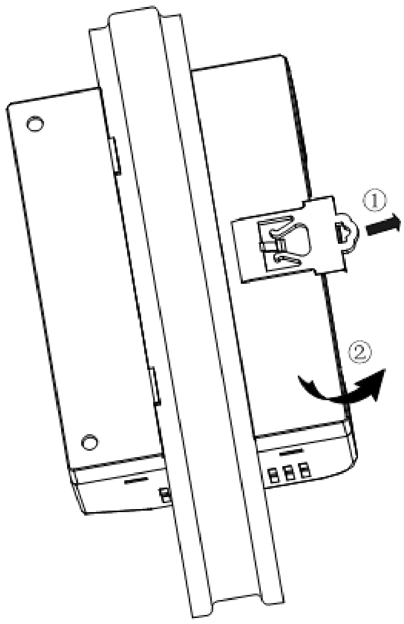


Figure 12.25: Uninstalling the terminal modul from the rail

12.3 TECHNICAL SPECIFICATION

LK3310 Universal Terminal Module	
Physical features	
Dimensions (W x H x D)	108.5mm×100mm×67.5mm
Installation	Standard 35 mm DIN rail
Working Environment	
Working Temperature	0℃~60℃
Working relative humidity	5%~95%, no condensate
Storage temperature	-40℃~70℃
Storage relative humidity	5%~95%, no condensate
Electrical specifications	
Onsite wiring terminal rated current	22A
Onsite wiring terminal rated voltage	250Vrms
Onsite wiring terminal voltage insulation	>1000Vrms @ 50Hz
Rated current for cable connector pins	5A
Rated voltage for cable connector pins	300Vrms
Voltage insulation between pins in cable connector	>1000Vrms @ 50Hz

Table 12.1: Technical specification of the LK3310 universal terminal module

Chapter
13

CHAPTER 13: POWER SUPPLY MODULE

13.1 LK910 [24V DC POWER SUPPLY MODULE]

13.1.1 Feature

- Input voltage: 100VAC~120VAC/200~240VAC, selectable using a switch
- Output voltage: 24V DC
- Rated power: 120W
- Input and output isolation
- Support 1+1 redundancy
- Output short-circuit / Overheat protection
- Output overload and Over voltage protection
- Output status feedback

LK910 achieves the conversion from 110V AC/220V AC to 24V DC with input/output isolation, and the rated power is 120W. LK 910 comes with output short-circuit protection, and the power supply is restored automatically when the problem is resolved. It also allows output status enquiries. When the output of the power supply is normal, the status switch is closed, otherwise it is open, which provides an interface for remote diagnostics of the working status of the power supply.

LK910 has a modular design. The overall structure is made from aluminum material, which is resistant to shock and interferences.

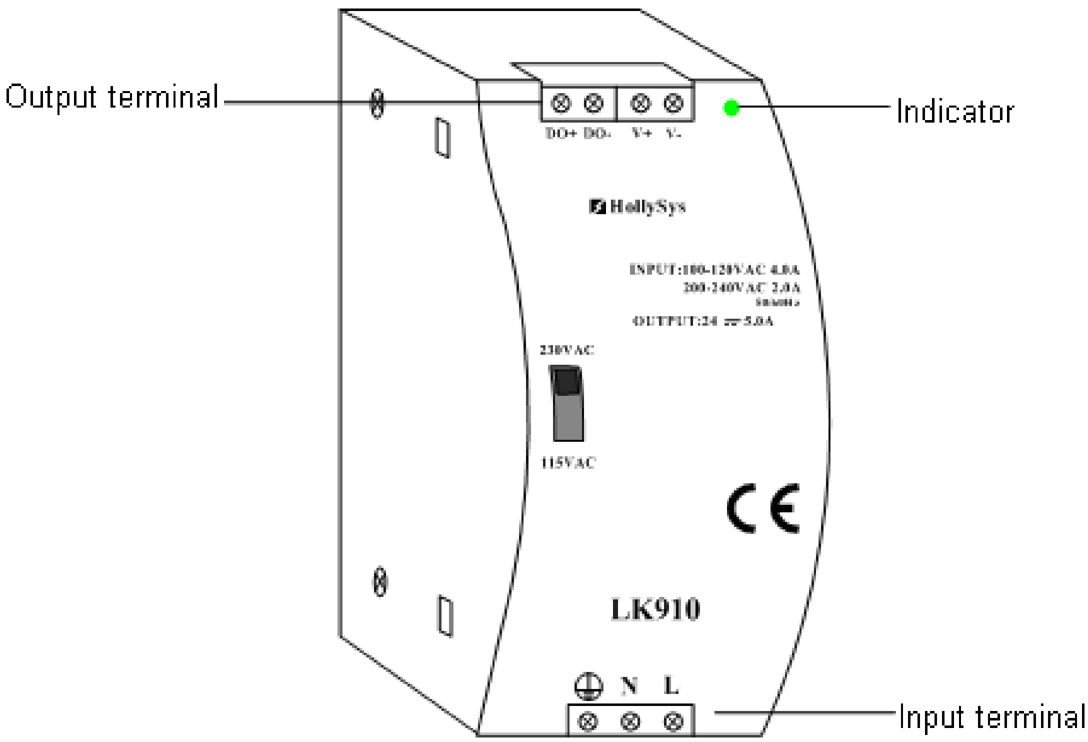


Figure 13.1: LK910 - 24VDC Power Supply Module

13.1.2 Operating Principle

- The input of the LK910 power supply module can be either 110V AC or 220V AC.
- The output is 24V DC after going through EMI suppression, rectification and filtering circuitry.

- Consisting of input protection, input filter, input protection and noise filter circuits, the AC input of LK910 module performs the rectification and filter functions and suppresses electromagnetic interferences transmitted from power lines to ensure a clean AC input. The module then gives a 24V DC output through control circuits of over-voltage protection and current limit protection, and displays working status of the power supply through alarm output terminals "DO+" and "DO-".The alarm output circuit uses optical coupler that is ON when the module operates normally to turn on the "DC OK" indicator, and is OFF when under-voltage occurs to turn off the indicator.

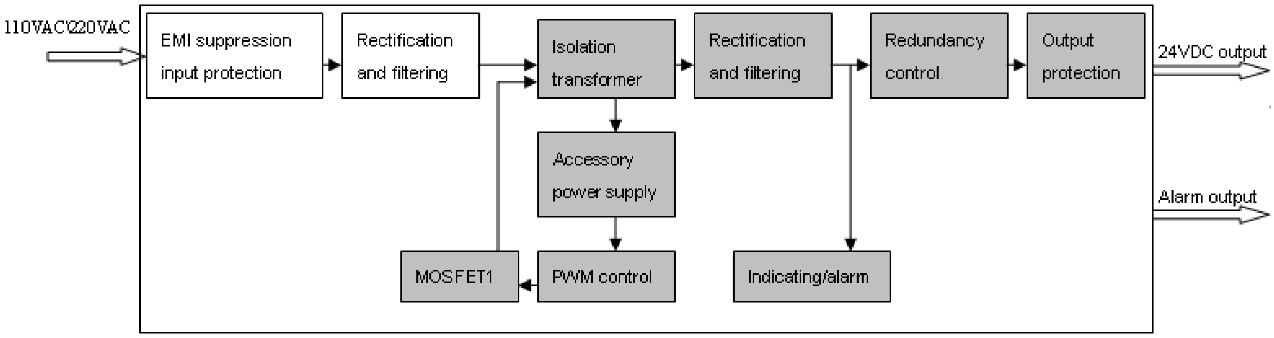


Figure 13.2: LK910 Operating Principle

13.1.3 Status Indicators and wiring terminals

- When the power is on, the "OK" indicator on the front panel will display the current working status. When the power supply works normally, the status indicator "OK" will be on.
- The wiring terminals are located on the top and bottom ends of the module. The top terminals are 24V DC output terminal and alarm output terminal while the bottom ones are for AC input. Please refer to Figure 13.3 for more detailed definitions.

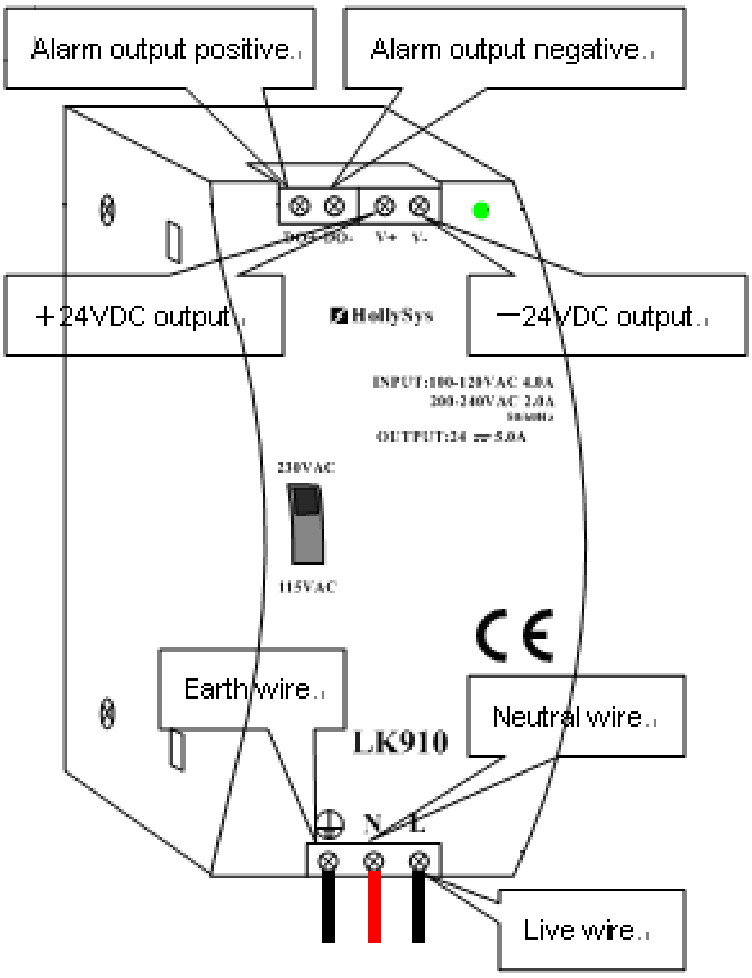


Figure 13.3: Wiring terminals of LK 910

13.1.4 Parallel Redundancy

For better system reliability, two or more LK910 power supply modules can be connected in parallel to provide redundancy. This reduces the problems caused by power supplies. Parallel redundancy configuration employs rectifier diodes to achieve dual redundant power supplies. This 1+1 configuration shall enable uninterrupted switch of power supply and on-line changes. The redundancy configuration is shown in Figure 13.4.

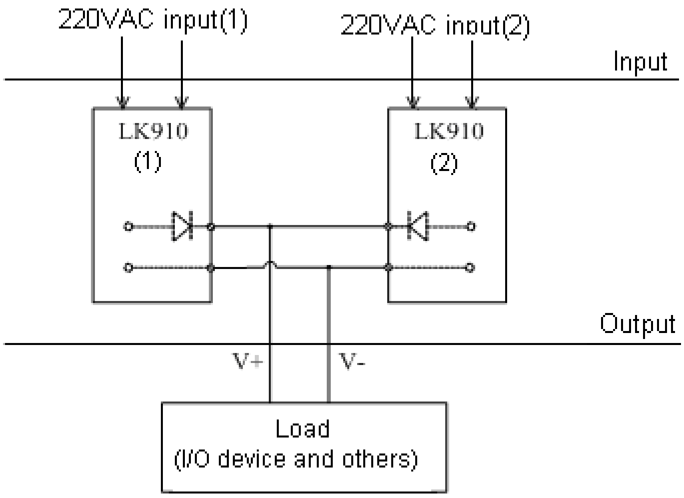


Figure 13.4: Redundancy configuration of LK910

13.1.5 DIN Rail Installation

LK910 module employs standard DIN rail installation. Installation slots can be found at the back of the module as shown in Figure 13.5:

- Step 1: Tilt the module so that the upper slot fits into the edge of the DIN rail.
- Step 2: Push the module gently so that the lower slot fits into the edge of the DIN rail. The module is installed correctly after a clip sound.

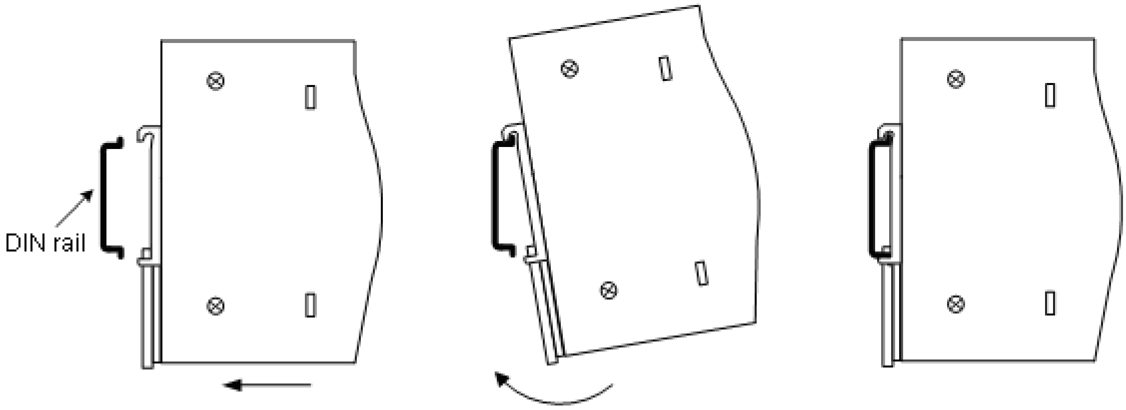


Figure 13.5: DIN rail installation for LK910

13.1.6 Dimensions

The exterior dimensions of the module are as shown in Figure 13.6.

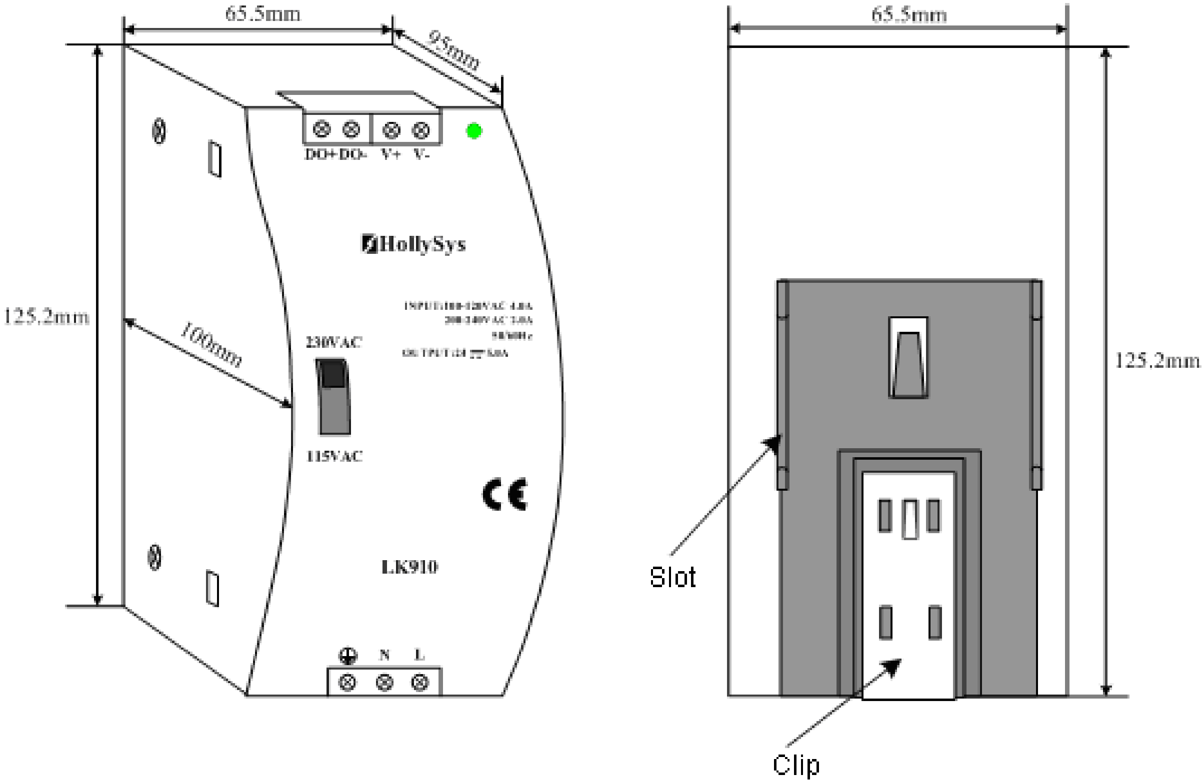


Figure 13.6: Exterior dimensions of LK910

13.1.7 Technical Specifications

LK910 24V DC power supply technical specifications	
Input	
Input voltage range	100VAC~240VAC
Input frequency range	47Hz~63Hz.
Output	
Rated output	24VDC
Output voltage error range	±5%
Rated output current	5A
Rated power	120W
Ripple (including noise)	<240mV
Load regulation	<±5%
Voltage regulation	<±2%
Step load response	<±5%@load change from 20% to 70%, stabilization time < 50ms
Conversion efficiency	>80%
Holdup time	When input is 220V AC and under 70% load, the holdup time is 30ms with no less than 95% of rated voltage.
Cooling	Natural cooling
Power on soft start	After power-on, the output voltage increases gradually, peak output voltage < rated voltage ±5%
1+1 parallel redundancy	Supported
Output overload protection	105% - 150%. Automatic recovery after overload disappears.
Output over voltage protection	120% - 140% of the rated voltage
Output short-circuit protection	Output short circuit protection. Power supply automatically recovers after the problem is resolved.
Power failure status output	When the power supply is working normally, the status switch is closed, otherwise it is open. The status switch is isolated from the power supply.
Output status indicator	Indicator is lit up when the output is normal.
Insulation	
Insulation resistance	Input and casing: 500VDC，>100MΩ Input and output: 500VDC，>100MΩ Output and casing: 500VDC，>100MΩ
Insulation voltage	Input and casing: 1500Vrms, 1min Input and output: 3000Vrms, 1min Output and casing: 500Vrms, 1min
Environment temperature	
Working temperature	-10 ℃~ 60 ℃, full load output at 60 ℃.
Storage temperature	-20℃~80℃
Relative humidity	5%~95%, no condensate
Physical features	
Dimensions	Width x height x depth = 65.5mm×125.2mm×100mm
Weight	790g
Installation	Standard rail installation
Indicator	Green
Standards and certifications	
Safety certificate	UL508,TUV EN60950,CE
EMC	EN55022/EN55011 class B
	EN61000-4-2,3,4,5,6,8,11
	EN61000-3-2,3
	EN61000-6-2
	ENV50204

Table 13.1: Technical Specification of LK910 24VDC Power Supply Module